DOCUMENT RESUME

ED 022 965 08 VT 007 031

By-Maley, Donald; Mietus, Walter S.

THE IMPLEMENTATION AND FURTHER DEVELOPMENT OF EXPERIMENTAL CLUSTER CONCEPT PROGRAMS THROUGH ACTUAL FIELD TESTING AND EVALUATION AT THE SECONDARY SCHOOL LEVEL. THE CLUSTER CONCEPT PROJECT. PHASE III. INTERIM REPORT.

Spons Agency-Office of Education (DHEW), Washington, D.C.

Bureau No-BR-7-0853

Pub Date Aug 68

Grant-OEG-0-8-000853-1865(085)

Note-438p.

EDRS Price MF-$1.75 HC-$17.60

Descriptors-ACHIEVEMENT TESTS, BUILDING TRADES, COGNITIVE ABILITY, COMPARATIVE ANALYSIS, CONTROL GROUPS, *CURRICULUM DEVELOPMENT, ELECTRICAL OCCUPATIONS, EXPERIMENTAL GROUPS, *EXPERIMENTAL PROGRAMS, GRADE 11, HIGH SCHOOL STUDENTS, METAL WORKING OCCUPATIONS, *OCCUPATIONAL CLUSTERS, PILOT PROJECTS, PROGRAM DESCRIPTIONS, *PROGRAM EVALUATION, QUESTIONNAIRES, *TRADE AND INDUSTRIAL EDUCATION, VOCATIONAL INTERESTS

Identifiers-CCP, Cluster Concept Program, Maryland

The Cluster Concept Program in vocational education, a program for the 11th and 12th grades, is designed to prepare youth for entry level capability in a variety of related occupations rather than a specific occupation. Phase III of research with the program was the evaluation of the first year of experimentation with the programs for the 11th grade. A pretest-post test research design with four control and four experimental construction cluster groups, four control and three experimental metal fabrication cluster groups, and three control and three experimental electromechanical cluster groups was used to estimate the program effectiveness. Newly developed measurement instruments and standardized tests were used to estimate changes in selected cognitive, affective, and psychomotor behaviors. Objectives were attained in varying degrees with significant gains in cognitive abilities in eight experimental groups and modest gains in two groups. Increased flexibility of occupational preferences and broadened interests were found in the experimental groups. Inadequacies identified from the evaluation will serve to establish a list of realistic recommendations for the further development of the programs. The appendixes contain measurement instruments and achievement tests used in program evaluation. Related documents are VT 002 356, VT 002 254, and VT 004 162-VT 004 165. (HC)

cl

INTERIM REPORT

PROJECT NUMBER 7-0853

GRANT NUMBER OEG-0-8-000853-1865 (085)

THE IMPLEMENTATION AND FURTHER DEVELOPMENT OF EXPERIMENTAL CLUSTER CONCEPT PROGRAMS THROUGH ACTUAL FIELD TESTING AND EVALUATION AT THE SECONDARY SCHOOL LEVEL

PHASE III

AUGUST 1968

U. S. DEPARTMENT OF
HEALTH, EDUCATION, AND WELFARE

OFFICE OF EDUCATION
BUREAU OF RESEARCH

VT007931

ED022965

INTERIM REPORT

Project Number 7-0853
Grant Number OEG-08-000853-1865 (085)

THE IMPLEMENTATION AND FURTHER DEVELOPMENT OF EXPERIMENTAL CLUSTER CONCEPT PROGRAMS THROUGH ACTUAL FIELD TESTING AND EVALUATION AT THE SECONDARY SCHOOL LEVEL,

The Cluster Concept Project, Phase III. Interim Report.

Dr. Donald Maley
Principal Investigator
Professor and Head
Industrial Education Department

Dr. Walter S. Mietus
Research Coordinator
University of Maryland
College Park, Maryland

August 1968

The research reported herein was performed pursuant to a grant with the Office of Education, U.S. Department of Health, Education, and Welfare. Contractors undertaking such projects under Government sponsorship are encouraged to express freely their professional judgment in the conduct of the project. Points of view or opinions stated do not, therefore, necessarily represent official Office of Education position or policy.

U.S. DEPARTMENT OF
HEALTH, EDUCATION, AND WELFARE

Office of Education
Bureau of Research

U.S. DEPARTMENT OF HEALTH, EDUCATION & WELFARE
OFFICE OF EDUCATION

THIS DOCUMENT HAS BEEN REPRODUCED EXACTLY AS RECEIVED FROM THE PERSON OR ORGANIZATION ORIGINATING IT. POINTS OF VIEW OR OPINIONS STATED DO NOT NECESSARILY REPRESENT OFFICIAL OFFICE OF EDUCATION POSITION OR POLICY.

TABLE OF CONTENTS

page

LIST OF TABLES iv

ACKNOWLEDGEMENTS vii

SUMMARY OF PROJECT viii

PART I

INTRODUCTION 1

- A. Summary of Previous Research 1
- B. Rationale and Justification for Cluster Concept . . . 2
- C. Establishing Cluster Concept Programs 10
- D. Summary 24

PART II

THE STUDY OF THE EFFECT OF THE FIRST YEAR OF FIELD RESEARCH . 26

- A. Introduction 26
- B. Purposes and Problems 27
- C. The Effect of the Cluster Concept Programs on Student Behaviors 30
- D. Presentation of Data and Findings 41
- E. Treatment of Data and Findings 44
  - 1. Construction Cluster 44
  - 2. Metal Forming and Fabrication Cluster 55
  - 3. Electro-Mechanical Cluster 66
  - 4. Summary 73

Page

PART III

EVALUATION OF CLUSTER CONCEPT PROGRAMS 120

A. Introduction 122

B. Construction Cluster 122

1. Course Objectives 122

2. Description of Construction Cluster Programs. . 123

3. Summary and Recommendations 129

C. Metal Forming and Fabrication Cluster 187

1. Course Objectives 187

2. Description of Metal Forming and Fabrication Cluster 189

3. Summary and Recommendations 193

D. Electro-Mechanical Cluster 260

1. Course Objectives 260

2. Description of Electro-Mechanical Cluster . . . 261

3. Summary and Recommendations 266

PART IV

SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS 295

A. Research Summary of Phase Three 296

1. Cognitive Behaviors 298

2. Affective Behaviors 304

3. Final Statement 316

APPENDICES 317

LIST OF TABLES

Table | page

1 Varibles of Pre and Posttests 28

2 Data and Reliability Estimates of Cluster Concept Tests . 34

3 Number of Subjects Completing the Programs 39

4 Homogeneity of Variance Between Groups Within Each School (Based on I.Q. Scores) 73

5 Means and Standard Deviations Derived from Intelligence Tests 74

6 Homogeneity of Variance Between Groups Within Each School (Based on Pretest of Achievement) 75

7 Means and Standard Deviations Derived from Cluster Program Achievement Tests 76

8 Analysis of Variance of Construction Achievement Test Scores, Experimental vs. Control Group on Pretest and Posttest Measures 77

9 Analysis of Variance of Intelligence Test Scores Between the Experimental and Control Groups of the Construction Cluster Program 78

10 Analysis of Variance for Differences Between Pre and Posttest Measures of Achievement (Based on Construction Cluster Tests) 79

11 Analysis of Variance for Differences Between Pre and Posttest Measures of Achievement (Based on Construction Cluster Tests) 80

12 Analysis of Variance of Construction Achievement Test Scores, Experimental vs. Control Group on Pretest and Posttest Measures 81

13 Analysis of Variance of Metal Forming and Fabrication Achievement Test Scores, Experimental Groups vs. Control Group on Pretest and Posttest Measures 82

Table page

14 Analysis of Variance for Differences Between Pre and Posttest Measures of Achievement (Based on Metal Forming and Fabrication Test) 83

15 Analysis of Variance of Intelligence Test Scores Between the Experimental and Control Groups of the Metal Forming and Fabrication Cluster Program 84

16 Analysis of Variance of Metal Forming and Fabrication Achievement Test Scores, Experimental Group vs. Control Group on Pretest and Posttest Measures. 85

17 Analysis of Variance for Differences Between Pre and Posttest Measures of Achievement (Based on Metal Forming and Fabrication Test) 86

18 Means and Standard Deviations Derived from the Mechanical Reasoning Abilities Test (D.A.T.) 90

19 Homogeneity of Variance Between Groups Within Each School (Based on Pretest Mechanical Reasoning) 91

20 Analysis of Variance of Data from Mechanical Reasoning Abilities Test (D.A.T.) Experimental Group vs. Control Group on Pre and Posttest Measures 92

21 Analysis of Variance of Data from Mechanical Reasoning Abilities Test (D.A.T.) Experimental vs. Control Group on Pre and Posttest Measures 93

22 Analysis of Variance of Data from Mechanical Reasoning Abilities Test (D.A.T.) Experimental vs. Control Group on Pre and Posttest Measures 94

23 Analysis of Variance of Data from Mechanical Reasoning Abilities Test (D.A.T.) Experimental vs. Control Group on Pre and Posttest Measures 95

24 Analysis of Variance of Data from Mechanical Reasoning Abilities Test (D.A.T.) Pretest vs. Posttest 96

25 Analysis of Variance of Data from Mechanical Reasoning Abilities Test (D.A.T.) Pretest vs. Posttest 97

26 Analysis of Variance of Data from Mechanical Reasoning Abilities Test (D.A.T.) Pretest vs. Posttest 98

27 Analysis of Variance of Data from Mechanical Reasoning Abilities Test (D.A.T.) Pretest vs. Posttest 99

Table		page
28	Mann-Whitney U Test Summary Tables	100
29	Mann-Whitney U Test Summary Tables	101
30	Summary Table of Omega Squares for Estimates of Treatment Effects Between Posttests Obtained from Experimental vs. Control Groups	102
31	Results of Selected Emperical and Homogeneous Scales from the Minnesota Vocational Interest Inventory	105
32	Results of Selected Emperical and Homogeneous Scales from the Minnesota Vocational Interest Inventory	110
33	Preparational Modes Identified as Most Important for Occupational Entry by Cluster Concept Students	112
34	Student Occupational Choices by Cluster	113
35	Student Responses to Specified Occupational Characteristics	114

ACKNOWLEDGEMENTS

The Cluster Concept research staff of the University of Maryland is indebted to the teachers who energetically implemented the programs under study. Many problems which interjected burdens upon the daily process of pedagogy were encountered. Teacher resourcefulness and additional time for study and preparation far beyond the usual expectations were demanded for the implementation of the new programs.

The research staff wishes to express its gratitude to Mr. James L. Reid, Director of the Division of Vocational Education and to Mr. Warren Smeltzer, Assistant Director of Vocational Education of the Maryland State Department of Education.

Grateful appreciation is directed to all of the county supervisors and high school principals who contributed in a variety of significant ways to the completion of the first year of research. The decision was made that within this evaluative study the names of these educational leaders and teachers would remain anonymous.

The principal investigator is pleased to acknowledge the work done by Walter Mietus, the director of the research and for the preparation of this document, and to the research associates: Andrew Baron, Luther Burse, John Gallinelli, and Kenvyn Richards, and to a diligent secretary, Rose Marie Dorn.

Donald Maley
Department Head and Principal Investigator
August, 1968

SUMMARY OF PROJECT

Introduction

This report is a summary of the third phase of research with the cluster concept programs. The first phase of research established the acceptability and feasibility of cluster programs and curricula for the occupational clusters of construction, metal forming and fabrication, and electro-mechanical installation and repair. The completion of phase II resulted in the production of curriculum guides, course outlines, instructional materials,and the selection and training of teachers to implement the programs. Phase III which is reported herein is an evaluation of the first year of experimentation with the programs of vocational education designed for the eleventh grade. Phase IV or experimentation with the twelfth grade level remains to be completed.

Full control of all the variables necessary for an ideal experiment was not achieved; therefore, this study was completed in the tradition of quasi-experimental design with full recognition of the factors which render the results equivocal.

Subjects from ten senior high schools in four Maryland counties have participated in this project. One school had two cluster programs, each taught by a cluster concept instructor; thus, eleven teachers and eleven separate cluster programs were included. Each cluster program was compared with a control group composed of students from a traditional vocational education course. Each school was considered and evaluated as a separate experiment.

Problems. To obtain an indirect estimate of the effectiveness of the cluster concept programs, three principal areas of investigation were conducted. These were:

1. The impact of the three cluster concept programs on selected cognitive, and affective behaviors, and task performances (psychomotor behaviors) of students.
2. The adequacy and appropriateness of the content of the newly developed course and instructional materials.
3. The educational process, its adequacy and appropriateness with a consideration of administrative support, teacher effectiveness,and selected environmental conditions.

To investigate the first area (1) of research, the changes of behaviors of subjects from the experimental and control groups were evaluated by the administration of a battery of tests at the beginning and at the end of the school year. The tests included newly developed achievement tests for each cluster, the Minnesota Vocational Interest Inventory, the D.A.T. Mechanical Reasoning Test, and an instrument to evaluate the students' knowledge of occupational information.

Treatment of data. Comparability or homogeneity of the students forming both groups was established on the basis of intelligence test scores (lingual or verbal abilities), and in one school, on the Mechanical Reasoning Test. In all but two experiments the analysis of variance statistic was used to determine whether there were significant differences between the two groups on the basis of the derived data. Prior to testing for differences, the F max ratio was used to determine homogeneity of variances. Non-parametric statistics were used in two experiments. The .05 level of significance was considered minimal in all data analyzed.

Findings. Statistical analysis of achievement test data indicated the following:

(a) Three construction cluster programs out of four achieved significantly higher scores than the control group. Three schools also were distinguished as making significant gains on the basis of initial and final scores. One school made very modest insignificant gains. None of the control groups achieved significant gains on the achievement tests.

(b) All four schools implementing the metal forming and fabrication cluster program made significant gains on the achievement tests; whereas no significant differences were observed from the control groups. All experimental groups achieved significantly higher scores than the control groups on the posttests.

(c) Three schools initially were involved with the implementation of the electro-mechanical installation and repair cluster. Due to many failures to meet the specifications presented, one school operation was discontinued.
Of the two schools, neither achieved significant gains or significantly higher scores than the control group..

(d) Data derived from the D.A.T. Mechanical Reasoning Test (from each of the ten experimental and control groups) indicated that both types of vocational education programs had insignificant effects on the development of the abilities required to solve problems of applied science and technology.

Affective behaviors. Both groups were administered the MVII and the supplementary questionnaire at the beginning and at the end of the school year.

Findings. The data derived from the MVII were perplexing and generally unsatisfactory for a clear group analysis. No clear patterns or directions of student vocational preferences were found. The cluster groups showed more flexibility of occupational choice than did the control groups.

Within the various groups of subjects, it was found that between twenty-five and forty percent of boys were dissatisfied with high school and would prefer to be gainfully employed or to pursue on-the-job training.

The number of students who expressed an appreciation for obtaining broad entry level skills,as opposed to specific in-depth training in high school,increased significantly.

Task performances. In the second (2) area of study, field observations and records of specific overt behaviors of students and teachers were made. The specific behaviors were referred to as job tasks and were set forth in objective behavioral terms. The tasks were incorporated into the course materials, inventory charts,and evaluation charts. The teachers' progress in implementing the instructional materials and student progress were recorded by the use of these devices.

Findings. The range of tasks completed by the instructors of the construction cluster was from thirty-four to sixty-seven percent. Of the tasks completed from fifty to sixty-six percent of the tasks must be restudied by the students.

The metal forming and fabrication cluster group completed from fifty to sixty-seven percent of the tasks. Of these, it was projected that twenty-five to thirty-four percent of the tasks must be retaught.

The instructors implementing the electro-mechanical installation and repair cluster completed fifty percent of the tasks. Of these, two-thirds will be repeated in the second year.

The primary cause for the failure to complete specified tasks was due to the lack of equipment, materials, and tools. Causes for repeating tasks were: the complex nature of the tasks and the shortage of time for exercises due to delays in remodeling or in setting up laboratories.

The specific units of studies and tasks which have not been studied, or where only token experiences have been provided, were identified.

The third area (3) of investigation was concerned with the evaluation of selected supportive dimensions including: (a) administration, (b) the teacher, (c) physical facilities, and (d) community acceptance.

In addition to anecdotal records, the following devices were used to obtain research data: (1) personal vita and records of teachers, (2) survey inventory forms for tools, equipment, and materials for each cluster, (3) drawings and sketches of physical facilities, (4) visual mediums such as drawings, plans, photographs, and written descriptions of practical work performed while implementing the course outlines, and (5) student progress charts and student evaluation charts.

Findings: construction cluster. Administrative support from the state, county, and local levels ranged from enthusiastic verbal support to active participation in overcoming the problems of procurement of physical facilities, materials, and equipment. Since these problems were never fully resolved, various construction tasks were not completed. Consequently, the sequence and balance of the programs were disturbed.

Some tasks were overemphasized and in a few situations, omitted altogether.

Various activities of interaction with the community were observed. Resourceful teachers obtained materials from local industries and arranged for student employment during the summer months. One field operation reported job placement of ninety percent of the students.

Findings: metal forming and fabrication cluster. Four separate field operations were involved with implementing this type of cluster program. The programs were restricted in different ways and varying degrees due to the lack of equipment and materials. The use of shops which were designed for the study of a single occupation did not provide sufficient working area and in some cases sources of power had to be added. This group of cluster teachers was evaluated to be most effective in meeting the goals and objectives of their respective cluster programs.

Findings: electro-mechanical installation and repair. This cluster program did not escape the damaging effects caused by inadequate supplies, materials, and equipment. The requisition-acquisition time lag strongly suggests that all programs should have been in operation several years before the optimum potential of these programs could be achieved.

One field operation was dropped due to failures in meeting the specifications of the cluster programs.

Conclusions

The action research conducted provided data which made it evident that the cluster concept programs have the potential of becoming vigorous, alternate forms of vocational education. The programs changed student behaviors in the direction of the established objectives. Changes in cognitive abilities, broadened interests, flexibility of occupational choices within a cluster,and growth in performance tasks were observed.

The inadequacies identified served to establish a list of realistic recommendations for the further development and refinement of the cluster concept programs.

PART I

INTRODUCTION

This final report is an evaluation of the first year of field research with the cluster concept programs of vocational education. This report is limited in that it does not present detailed information relevant to the first two years of research and development which formed the foundations and which were presented in other documents. Researchers, practitioners, and others who seek a thorough understanding of this third report and the cluster concept programs are urged to make reference to previous documents which emerged as products and have become public domain. Two sources from which materials may be obtained are:

1. ERIC Clearing House
   The Center for Vocational &
   Technical Education
   The Ohio State University
   980 Kinnear Road
   Columbus, Ohio 43212

2. National Cash Register Company
   4936 Fairmont Avenue
   Bethesda, Maryland 20014

Summary of Previous Research

A brief summary of the rationale, objectives, activities, and accomplishments is presented to provide the reader with a proper orientation to the nature, scope, and background of the cluster approach to vocational education. It is hoped that this will help the reader in achieving closure. Also provided are certain critical aspects of the program which form the evaluative criteria such as task analyses and human requirements.

Phase I, or the first year efforts, began in September of 1965. During that time the cluster concept was investigated as a form of vocational education at the eleventh and twelfth grade of secondary education. The cluster concept, as envisioned, was aimed at the preparation of individuals for entry level capability in a variety of related rather than specific occupations. It was based on the premise that educational experiences with a range of related occupations appear defensible for most students who have no realistic basis for decision making along the lines of selecting a specific trade. The cluster concept program was designed to enhance the individual's potential employability by virtue of offering a wider range of entrance skills and a level of articulation across several occupational areas. This type of fundamental training, it is believed, will enable the individual to move back and forth over several occupational categories as well as vertically within the occupation.

Rationale and Justification for Cluster Concept

The rationale of the cluster concept program includes findings and recommendations from research in the fields of guidance, vocational placement, education, military training, and psychology. A sample of these is presented.

The cluster concept program was designed to provide secondary vocational students with a greater degree of flexibility for vocational decision making rather than being a commitment to "one-goal directed" traditional programs. The student has experience in a family of related occupations; the decision to select one single trade is not demanded. With a similar point of view, Baer and Roeber, in writing on the dynamics of vocational choice, concluded:

> Since most young people have a broad range of interests and capabilities, appropriate initial choices are facilitated by a knowledge of families of occupations. It is becoming more generally recognized that early training, even at the college level, should be broad enough to give the student the background for a group of related occupations. Thus he is not driven into a specific occupational choice before his interests have matured sufficiently for him to choose a field of work. When he is ready to enter the job market, his chances of successful placement are increased if he is prepared to begin at any one of several jobs in a given field of work. If this field happens to be commercial art, for example, he could become a poster artist, sign writer, catalog illustrator or layout man. Once hired, he has a better chance of promotion if he has been trained for a group of related occupations. Should he lose his job as a result of adverse business conditions or obsolescense of the occupation, he can switch to another job in the same occupational family.[1]

The final report of the panel of consultants on vocational education appointed by the Secretary of Health, Education, and Welfare contained the following recommendation:

> Basic vocational education programs should be designed to provide education in skills and concepts common to clusters of closely related occupations. The curriculum should be derived from analyses of the common features of the occupations included. These students should receive specialized or more advanced vocational training later in post high school programs, apprenticeships, or on-the-job experiences.[2]

Support for the soundness of the postponement of the decision to follow one trade due to distinct periods of vacilation in choice is provided by Eli Ginzberg who indicated:

---

[1] Max Baer and Edward C. Roeber, Occupational Information (Chicago: Science Research Associates, 1964), p. 167.

[2] U.S. Department of Health, Education and Welfare, Office of Education, Education for a Changing World of Work (Washington: Government Printing Office, 1964), p. 227.

> The period during which the individual makes what can be described as a fantasy choice; the period during which he is making a tentative choice; and the period when he makes a realistic choice. The first coincides in general with the latency period, between six and eleven, although residual elements of fantasy choices frequently carry over into the preadolescent years. The second coincides by and large with early and late adolescence;with a few exceptions, realistic choice is made in early adulthood. To some degree the way in which a young person deals with his occupational choice is indicative of his general maturity, and conversely, in assessing the latter, consideration must be given to the way in which he is handling his occupational choice problem.[3]

In a state-wide inquiry held in Wisconsin and sponsored by the U.S. Office of Education, J. K. Little obtained information relative to 4,186 non-college youth. Only 8.7 percent indicated plans for obtaining specific vocational education, but the action of the same body of students indicated that 15.9 percent went into vocational programs. While the forces prompting youth to acquire education beyond the high school are clearly visible, formal education ended at the end of high school for 60 percent of the group. For 73 percent, education stopped short of completing a baccalaureate degree.[4]

> An important item of unfinished educational business then is conceiving and developing realistic and practical programs of 'middle education' (occupations that include clerical, salesworkers, craftsmen, foremen and sub-professional technicians)--the level between mid-high school and mid-college--during which three fourths of American youth end

---

[3] Eli Ginzberg, Occupational Choice (New York: Columbia University Press, 1963), p. 160.

[4] Kenneth J. Little, "A State-Wide Inquiry into Decision of Youth about Education Beyond High School," American Educational Research Journal, 4:2, March (1967), p. 147.

> their formal schooling. These are the youth who as adult workers occupy the great range of middle level occupations and who as citizens are the bedrock of a democratic society.[5]

The 15.9 percent that enrolled into vocational programs represents a potential supply of sub-professional workers considerably lower than the demand. It would be reasonable to assume that if exploratory vocational experiences, such as the cluster concept, were provided high school youth, a greater number would elect to work in the sub-professional occupations. Evidence to test this hypothesis will be obtained with follow-up research on the students in the fourth phase of this study.

A nation-wide study of vocational course graduates based upon a representative sample of high schools was conducted under the sponsorship of the Ford Foundation and directed by Max Eninger.[6] It describes the salient post-high school occupational and educational experiences of 5,500 graduates of high school level trade and industry vocational courses. Data collected indicated that 43 percent of the students selected to study vocational courses on the basis of what the students perceived as job opportunity. This was based on incomplete information which had been directed to him concerning opportunities. This information did not necessarily correspond to actual job opportunity or to job opportunity after graduation.

---

[5] *Ibid.*

[6] Max U. Eninger, *The Process and Product of T&I High School Level Vocational Education in the United States* (Pittsburgh, Pennsylvania, American Institute for Research, 1965), pp. 5-16.

The second most frequently acknowledged influence was the parents; friends of the same age were third. The relatively small influence of school personnel is striking. Only 15.1 percent reported a school teacher and 12.3 percent reported that the counselors or guidance personnel had any influence on decisions to study vocational courses.

The percentage of vocational graduates who entered the trade for which they prepared was 29.8 percent, a percentage which decreases during years of low employment in the United States.

With due consideration of findings from other related studies and a survey study conducted for this research, definite needs were established which served as guidelines for the cluster concept programs. A sample of these is synthesized below, but is presented in complete detail in other documents mentioned previously.

1. _There is a need to provide students with a greater degree of mobility on a geographical basis._

The Bureau of Census reported:

> Of the 185.3 million persons one year old and over living in the United States in March, 1964, 36.3 million, or 19.6 percent, had been living at a different address in the United States in March, 1963 . . . The peak mobility rate occurred among persons in their early twenties--the age at which most young people leave their parental home to find employment . . .[7]

An implication for vocational education with reference to geographical mobility of the population was proposed by Kimball Wiles:

---

[7] U.S. Department of Commerce, Bureau of the Census, "Mobility of the Population of the United States, March 1963 to March 1964," _Current Population Reports_: _Population Characteristics_, September 7, 1965, Census Publication Series P-20, No. 141 (Washington, D.C.: Government Printing Office, 1965), p. 1.

> Vocational education can no longer be planned solely in terms of the community in which a high school exists. Over half of the average school's graduates will migrate to another community, and will go to another state. Seemingly, the wisest step for curriculum planners to take, then, is to study industrial and commercial operations and plan in terms of clusters of competencies. When a student has developed a particular set of abilities he may enter a variety of related occupations.[8]

The importance of mobility, on a geographical basis, was further emphasized by Grant Venn:

> Work mobility is important to occupational well being and competence in an economy increasingly subject to technological dislocation. A company moves to a new state; the award of a government contract causes thousands of jobs to be shifted from one state to another; a new invention wipes out an industry by making it obsolete; whole occupations and job titles are created and abolished--these and other phenomena mark the extent to which occupational education must prepare people to face change. The labor force needs to maintain a high degree of mobility, ability to move from one place to another, and from one job to another. Current rates of occupational and geographical mobility are high, but they are relatively low for the future needs of technology and are misleading as an indication of purpose and direction.[9]

2. There is a need to provide students with mobility for jobs within an industry or occupation.

The Bureau of Labor Statistics has found that "during 1961, some 8 million workers--10 percent of the number who worked--shifted from one employer to another . . ."[10] The rate of job changing in 1961 was highest among men and women between the ages of 18 and 24 who were largely unskilled and had little education.[11]

---

[8] Kimball Wiles, The Changing Curriculum of the American High School (Englewood Cliffs, New Jersey: Prentice Hall, Inc., 1963), p. 126.

[9] Grant Venn, Man, Education, and Work (Washington, D.C.: American Council on Education, 1965), p. 130.

[10] Gertrude Bancroft and Stuart Garfinkle, "Job Mobility in 1961," Special Labor Force Report, No. 35 (Washington, D.C.: U.S. Department of Labor, Bureau of Labor Statistics, 1963), p. 2.

An implication for the nature of vocational education was proposed by James E. Russell in the publication *Automation and the Challenge to Education*:

> . . . . therefore, to the extent that the school tries to develop employable skills, it should aim at transferable skills, and it should not attempt to train persons for specific jobs that are only temporarily open.[12]

In terms of the requirements of industry, Rumpf has stated that:

> Industry needs workers who are flexible, workers who have a field of skills and basic education that will enable them to adapt rapidly to occupational changes. Workers who are adaptable make installation of new methods and equipment more economical for employers. Management needs workers ready to move into its jobs without long periods of preparation.[13]

3. *There is a need to develop students who will be able to adapt to technological changes.*

The Department of Labor estimated that about 200,000 non-agricultural workers per year will be displaced because of technological change during the next decade.[14] In five case studies on the effects of plant layoffs and shut-downs, it was found that in each case technological change was a factor in worker unemployment.[15]

---

[11] *Ibid*.

[12] James E. Russell, "Educational Implications of Automation as Seen by an Educational Policy Planner," *Automation and the Challenge to Education*, Proceedings of a symposium sponsored by the Project on the Educational Implications of Automation (Washington, D.C.: National Education Association, 1962), p. 42.

[13] Edwin L. Rumpf, "Training-the Manpower Catalyst," *Manpower and Training Needs of the Food Industry*, Report of a National Conference, April 22-24 (Washington, D.C.: Government Printing Office, 1964), p. 10.

[14] Bancroft and Garfinkle, *loc. cit*.

[15] Ewan Clague and Leo Greenbert, "Technological Change and Employment," *Monthly Labor Review*, 85:741-746, 1962.

The future need to develop students of this caliber was further stressed in the Manpower Report of the President:

> Growth and change have characterized the American economy throughout our history, and continual adjustments to shifting manpower requirements by workers, employers, and training institutions have been the rule rather than the exception. Thus, the significant changes in patterns of demand for blue- and white-collar workers, for the skilled and less skilled, and for men and women workers since World War II were no new phenomena. The persistence of the under-lying factors--rising levels of living, associated shifts in consumer purchases, changes in government demand, technological innovations, and productivity growth--implies continued patterns of change in manpower demand.[16]

Peter Drucker, in an address given at the State University College, Oswego, New York, further supported this need:

> A reason why technological education needs to be a part of a general education is that it is no longer of much use to teach any one craft as such. Crafts change too fast. When I was a child forty years or so ago it was quite obvious that anybody who had ever learned a craft had learned enough for the rest of his life. This applied not only to the carpenter or the house painter but to the lawyer and doctor just as well. But today the one thing that is predictable about any craft is that in its present form it is not going to stay around very long. The good Lord did not ordain the crafts. They are man-made and therefore can be altered by man. Crafts that seemed to be as solid as the glacier granite of Upstate New York are dissolving all around us. We will see, for instance, predictably in the next twenty years or so, a complete change of the graphic arts crafts in which not one will remain the way it is. One can also say that this will not mean fewer skilled people, but it will mean people with different skills.[17]

Thomas Brooks supports this need on the basis that the chief traits in demand today are adaptability and versatility:

---

[16] U.S. Department of Labor, Manpower Report of the President (Washington, D.C.: Government Printing Office, 1965), p. 45.

[17] Peter Drucker, "Knowledge and Technology" (an address delivered at the State University College, Oswego, New York, May 6, 1964).

> It is not uncommon, says a foundry manager, for a man to work on twenty different jobs a year. We take advantage of change in work flow, absences and other factors to move our people around.[18]

An implication for vocational education relative to the impact of technological change was found in the Rockefeller Report on Education:

> In this day of technologies that become antiquated overnight, it is hazardous to predict a favorable future for any narrow occupational category. There will be economic advantage to the individual in acquiring the kind of fundamental training that will enable him to move back and forth over several occupational categories.[19]

Supportive evidence to build a rationale was found in abundance; one hundred and sixty studies were reviewed. To further determine the acceptability and feasibility of developing cluster concept programs, field research was conducted. Representatives from education, government, labor and management were consulted and their reactions were studied. The data gathered from these individuals strongly tended to indicate that students with a cluster concept background would be desirable potential employees and would be less difficult to adapt because of their broad, general, fundamental training. The data gathered also indicated that the implementation of the program into the public schools would not present any major difficulties and that graduates from these programs would be able to obtain employment.

Establishing Cluster Concept Programs

After making an analysis of the various available occupational classification systems, the decision was made to develop criteria for establishing occupational clusters and specific occupations within the clusters since existing systems were not suitable for developing cluster concept programs in vocational education. The following criteria were used:

---

[18] Thomas R. Brooks, "The Blue Collar Elite," _Dun's Review and Modern Industry_, Special Supplement, Part II, March 1964, p. 122.

[19] Rockefeller Brothers Fund, Inc., _The Pursuit of Excellence_ (Garden City, New York: Doubleday and Company, 1958), p. 10.

The occupational cluster should:

1. Be in the area of vocational industrial education.
2. Include occupations that are related on the basis of similar processes, materials, and products.
3. Be broad enough to include occupations with a wide variety of skills and knowledge.
4. Involve occupations that require not more than a high school education and/or two years beyond high school.
5. Provide for the opportunity for mobility on a geographical and occupational basis.

The three clusters established through the application of the criteria and limitations set for this research are presented in Figure 1. Each of the clusters was analyzed to establish special occupations for each category. The following criteria were used for selection.

The occupation selected must have:

1. A favorable employment outlook.
2. The instructional capability of being implemented in a secondary school program.
3. Opportunity for job entry upon graduation from high school.
4. Numerous skills and knowledge providing an opportunity for the identification of commonalities

with other occupations.

5. Opportunities for advancement through further schooling, on-the-job training, or apprentice programs.

Task inventories. Central to developing the cluster programs, and concurrently evaluating them, a task inventory of each occupation within a cluster was completed. The task statements were written in a clear, precise and non-ambiguous manner, and expressed in behavioral terms. The format of the task statements is shown in Figure 2. Each task statement began with a behavioral verb (a) which described the action involved in performing a task. The statement also included a noun (b) which described the object acted upon. Modifiers, such as adverbs and adjectives, were used in identifying the object acted upon. The results of the action (c) were stated which described the results of (a) and (b). Modifiers were used to clarify the results of the action and to specify the accuracy or limits that were required in the performance of the task. Whenever possible, the task statement specified the accuracy that was required in the performance of the task. By stating the tasks in this manner, validity was achieved; that is, the same criteria for measurement from one individual to another was transmitted and secondly, by observation task performances could be recorded.

A task describes the work performed by an individual in an occupation and consists of observable human behavior involving more than one area of human requirement. Human requirements, cognitive and psychomotor, that may be involved in the performance of work by an individual in an occupation include:

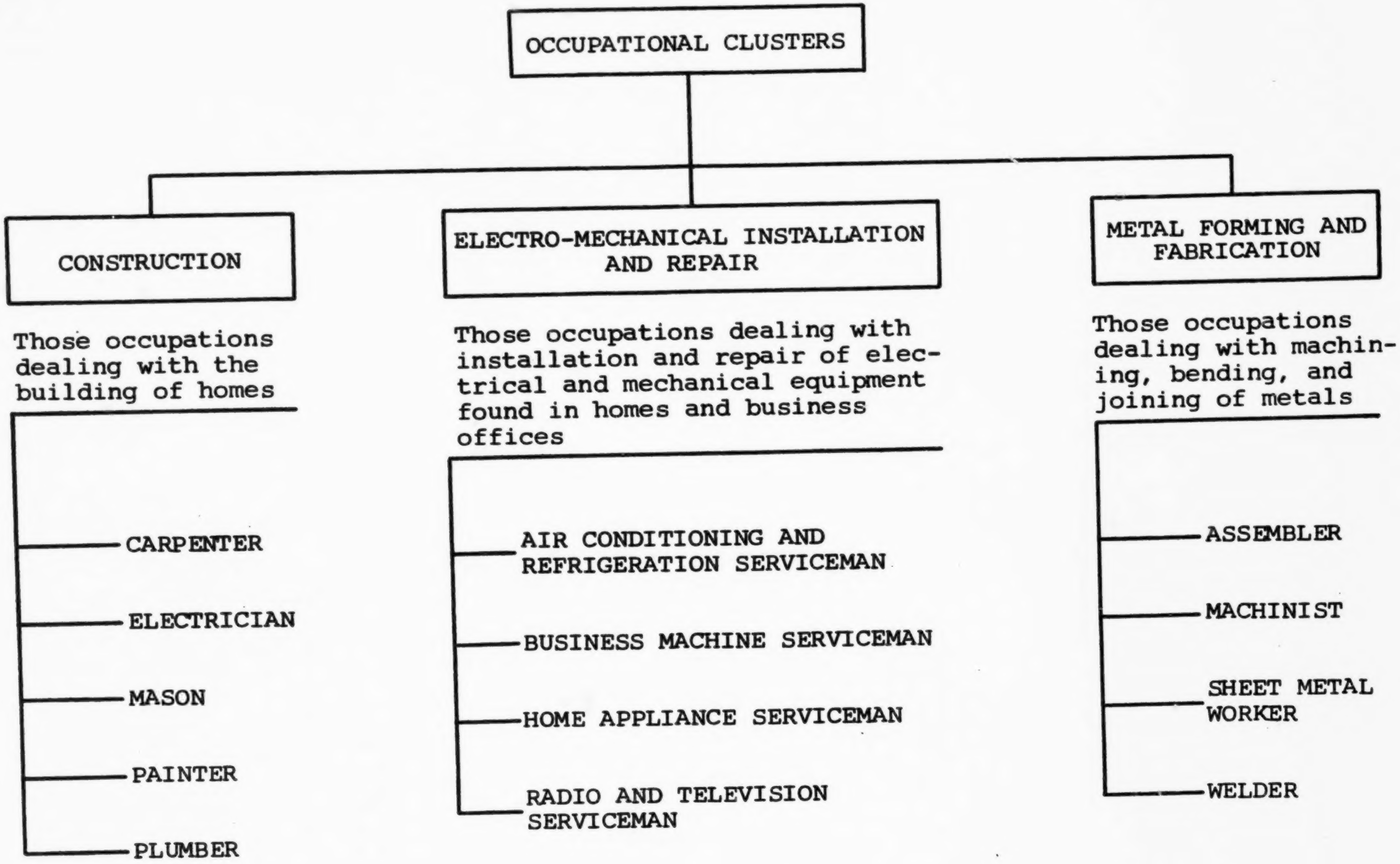

OCCUPATIONAL CLUSTERS
CONSTRUCTION
Those occupations dealing with the building of homes
CARPENTER
ELECTRICIAN
MASON
PAINTER
PLUMBER
ELECTRO-MECHANICAL INSTALLATION AND REPAIR
Those occupations dealing with installation and repair of electrical and mechanical equipment found in homes and business offices
AIR CONDITIONING AND REFRIGERATION SERVICEMAN
BUSINESS MACHINE SERVICEMAN
HOME APPLIANCE SERVICEMAN
RADIO AND TELEVISION SERVICEMAN
METAL FORMING AND FABRICATION
Those occupations dealing with machining, bending, and joining of metals
ASSEMBLER
MACHINIST
SHEET METAL WORKER
WELDER

Figure 1 Occupational Clusters

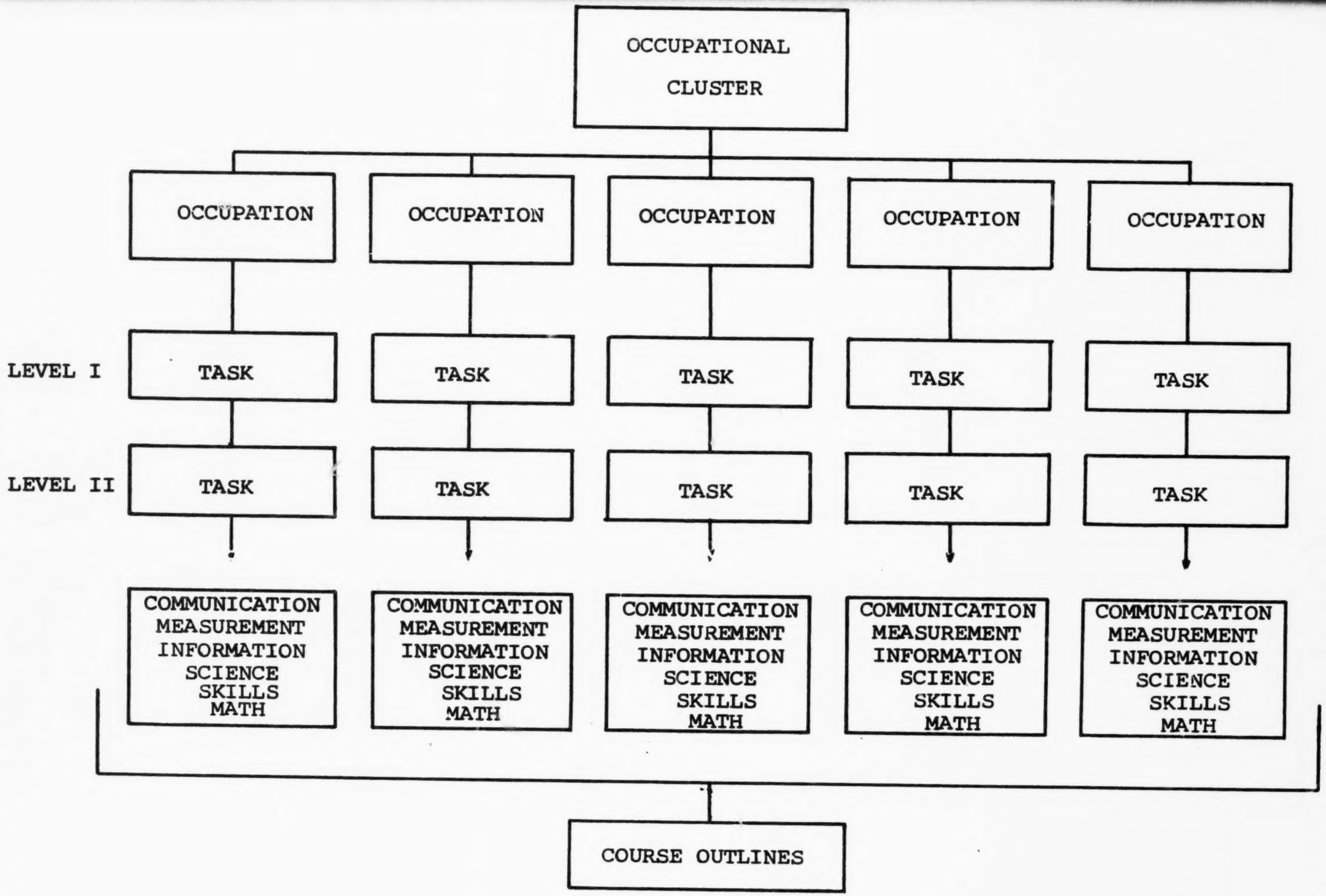

OCCUPATIONAL CLUSTER
OCCUPATION
OCCUPATION
OCCUPATION
OCCUPATION
OCCUPATION
LEVEL I
TASK
TASK
TASK
TASK
TASK
LEVEL II
TASK
TASK
TASK
TASK
TASK
COMMUNICATION MEASUREMENT INFORMATION SCIENCE SKILLS MATH
COMMUNICATION MEASUREMENT INFORMATION SCIENCE SKILLS MATH
COMMUNICATION MEASUREMENT INFORMATION SCIENCE SKILLS MATH
COMMUNICATION MEASUREMENT INFORMATION SCIENCE SKILLS MATH
COMMUNICATION MEASUREMENT INFORMATION SCIENCE SKILLS MATH
COURSE OUTLINES

Figure 2. Research Model for Developed Course Outlines

1. Communications
    - vocabularly
    - symbols
    - drawings and blueprints
    - systems of communication
    - speech
    - English
    - maps

2. Measurement
    - time
    - temperature
    - weight
    - volume
    - length, width, and depth
    - meters (electrical and mechanical)
    - instruments
    - systems of measurement

3. Skills
    - hand
    - mental
    - machine

4. Mathematics and Science
    - practical and applied

5. Information
    - technical
    - operational
    - occupational
    - economic
    - social
    - safety
    - personal hygiene
    - personal standards
    - occupational and job standards

With the cooperation of representatives from management and technical personnel, the tasks were classified into three categories:

1. Level 0

    The task is not needed for the occupation and would not be included for further analysis.

2. Level 1

    The task is needed for entry into the occupation and will be included for further analysis.

3. Level 2

The task is not needed for entry into the occupation but will be needed soon after entry and will be included for further analysis.

By this procedure, job entry tasks were identified as well as those tasks necessary on the job three months after being on the job. The completed task analyses and the identified areas of human requirement provided the basis for the course outlines, building objective achievement test items, student progress charts, evaluation of teacher progress, and evaluative criteria for use during visitations.

The activities of phase I as well as others are presented graphically in order of sequence in Figures 3, 4, 5, 6, 7.

PHASE II OF THE CLUSTER CONCEPT PROJECT

The second phase of the project was characterized as having as its chief aims the identification and development of competent teachers for implementing the cluster concept pilot studies.

The following procedures were established and carried out during the selection of teachers for the program:

1. The industrial education supervisors in the counties of Prince Georges, Montgomery, Frederick, and Washington recommended a group of teachers for possible participation in the program.
2. An interview was conducted with each teacher using a formal interview schedule to obtain information concerning teaching competencies. Further criteria for selection included:

School Facilities -The physical facilities of each teacher's shop were rated by the

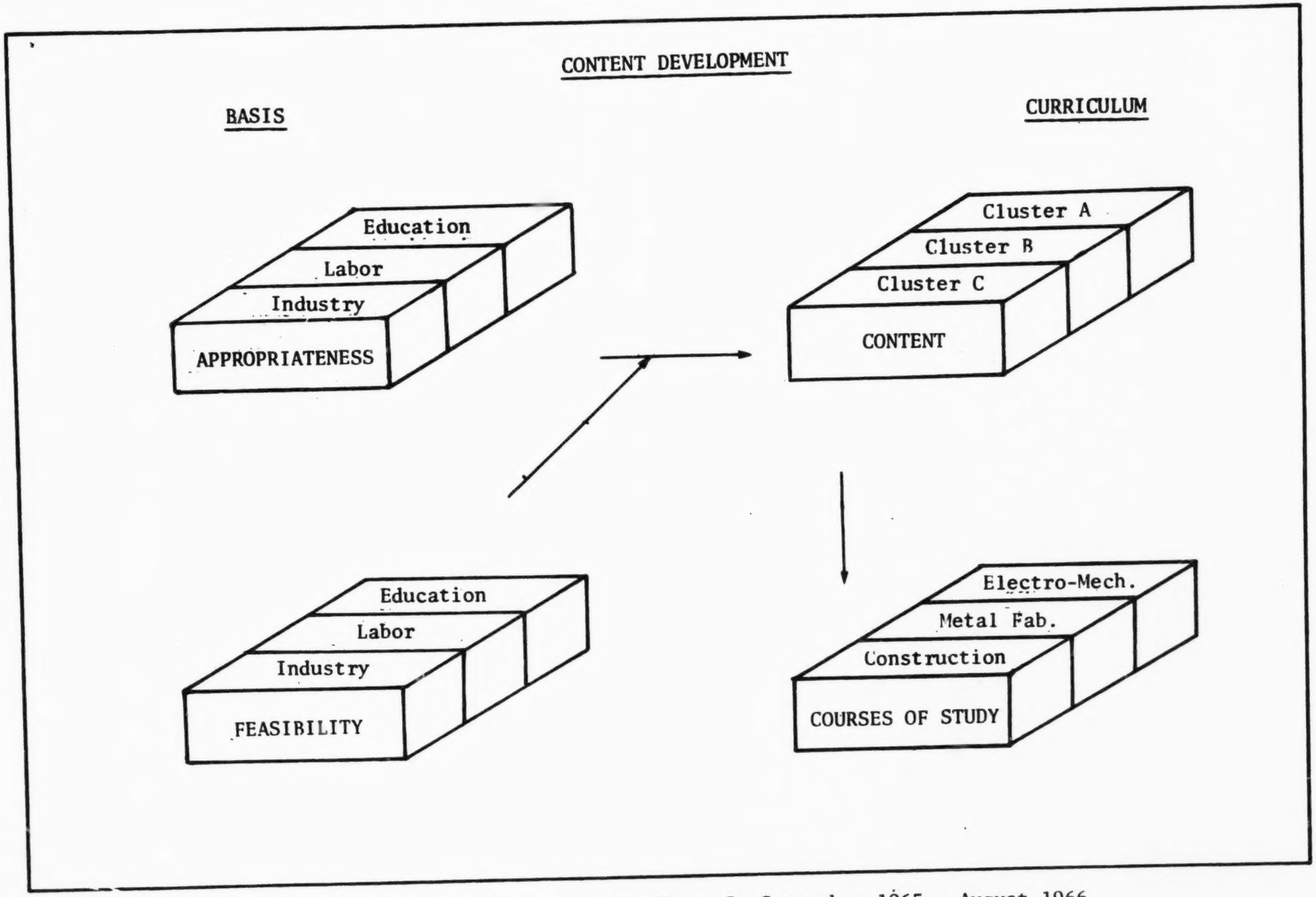
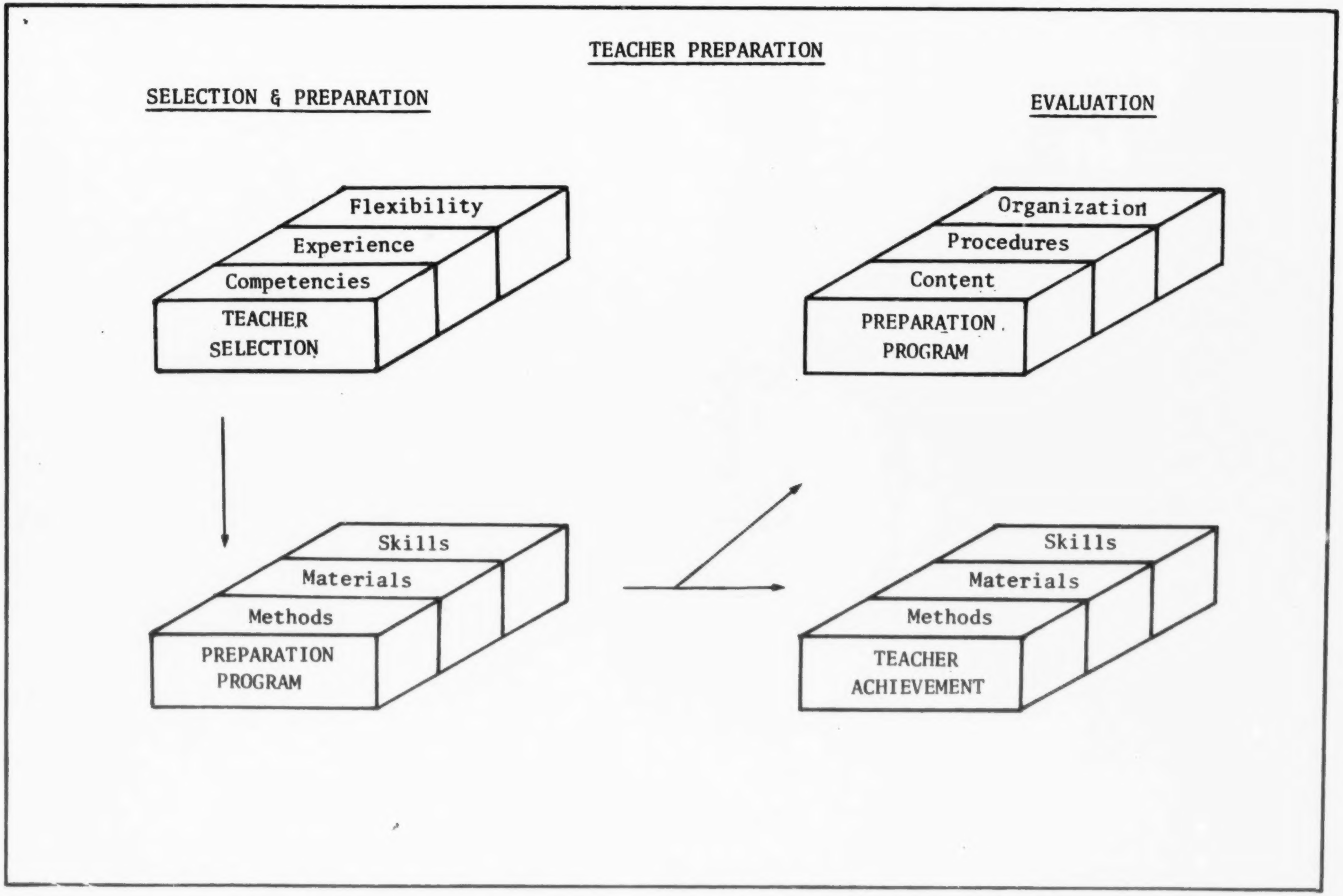

CONTENT DEVELOPMENT
BASIS
CURRICULUM
Education
Labor
Industry
APPROPRIATENESS
Education
Labor
Industry
FEASIBILITY
Cluster A
Cluster B
Cluster C
CONTENT
Electro-Mech.
Metal Fab.
Construction
COURSES OF STUDY

Figure 3. Cluster Concept Project Phase I, September 1965 - August 1966



TEACHER PREPARATION
SELECTION & PREPARATION
EVALUATION
Flexibility
Experience
Competencies
TEACHER SELECTION
Organization
Procedures
Content
PREPARATION PROGRAM
Skills
Materials
Methods
PREPARATION PROGRAM
Skills
Materials
Methods
TEACHER ACHIEVEMENT

Figure 4. Cluster Concept Project Phase II, September 1966 - August 1967

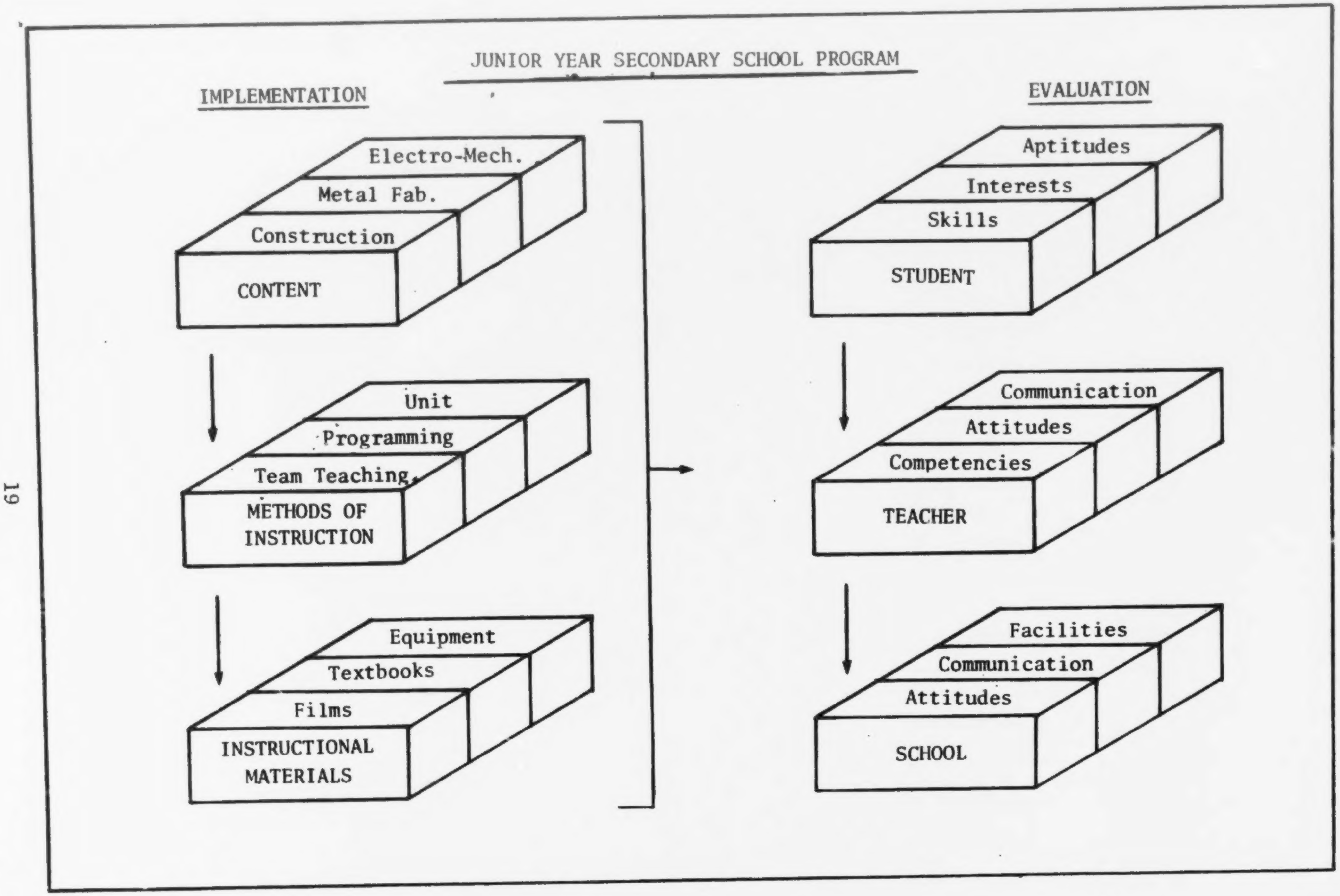

JUNIOR YEAR SECONDARY SCHOOL PROGRAM
IMPLEMENTATION
EVALUATION
Electro-Mech.
Metal Fab.
Construction
CONTENT
Unit
Programming
Team Teaching
METHODS OF INSTRUCTION
Equipment
Textbooks
Films
INSTRUCTIONAL MATERIALS
Aptitudes
Interests
Skills
STUDENT
Communication
Attitudes
Competencies
TEACHER
Facilities
Communication
Attitudes
SCHOOL

Figure 5. Cluster Concept Project Phase III, September 1967 - August 1968

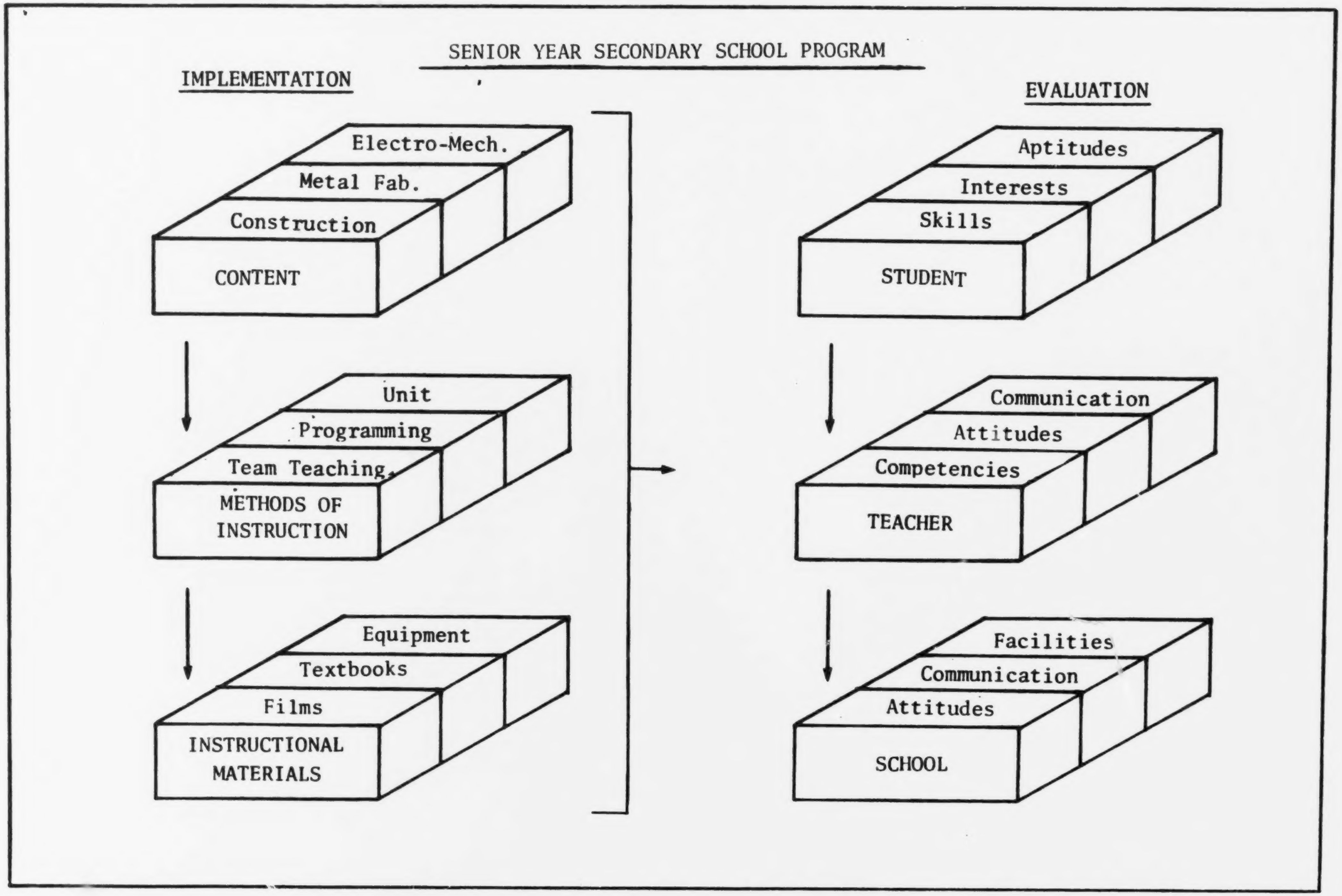

SENIOR YEAR SECONDARY SCHOOL PROGRAM
IMPLEMENTATION
EVALUATION
Electro-Mech.
Metal Fab.
Construction
CONTENT
Unit
Programming
Team Teaching
METHODS OF INSTRUCTION
Equipment
Textbooks
Films
INSTRUCTIONAL MATERIALS
Aptitudes
Interests
Skills
STUDENT
Communication
Attitudes
Competencies
TEACHER
Facilities
Communication
Attitudes
SCHOOL

Figure 6. Cluster Concept Project Phase IV, September 1968 - August 1969

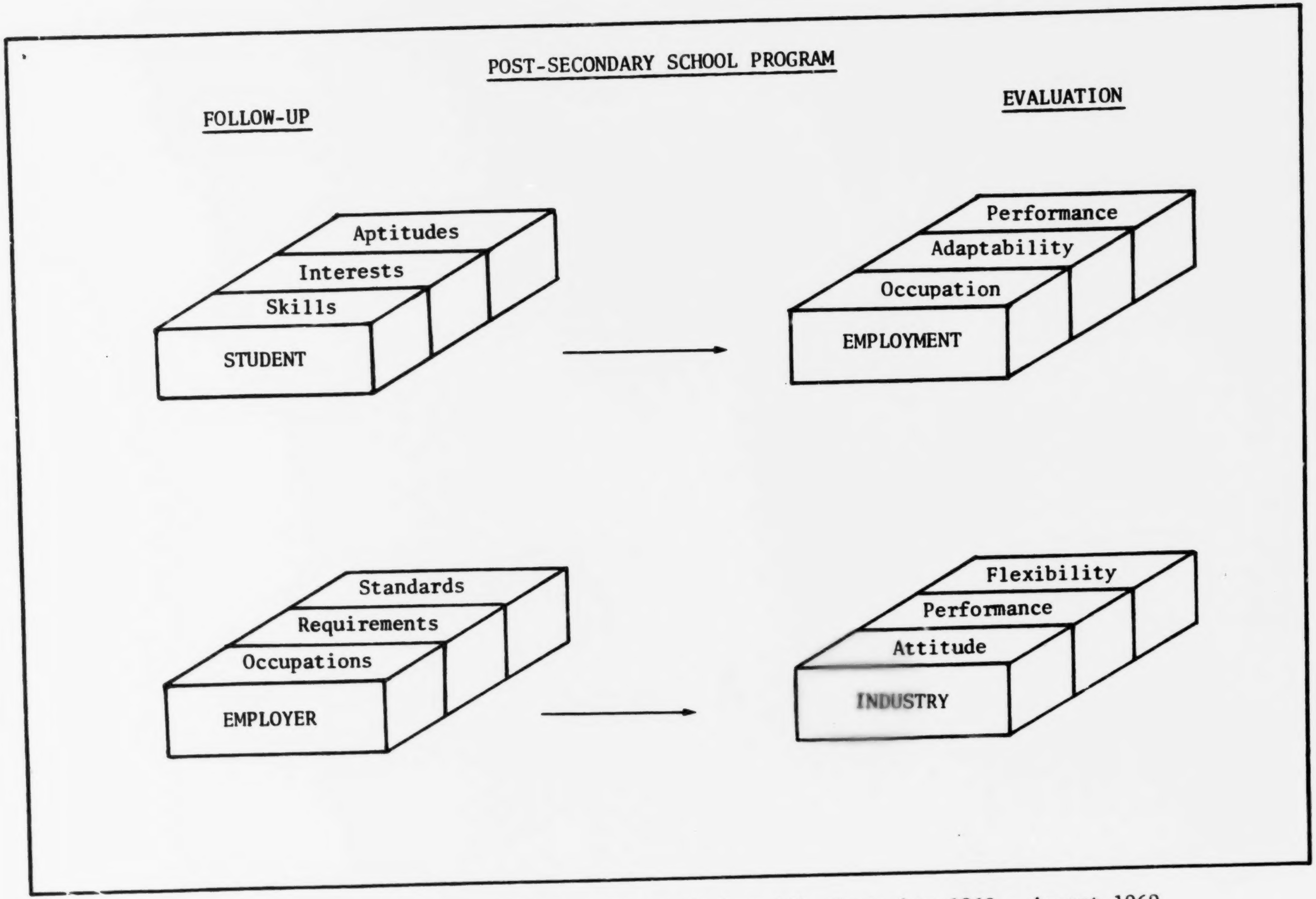

POST-SECONDARY SCHOOL PROGRAM
FOLLOW-UP
EVALUATION
Aptitudes
Interests
Skills
STUDENT
Performance
Adaptability
Occupation
EMPLOYMENT
Standards
Requirements
Occupations
EMPLOYER
Flexibility
Performance
Attitude
INDUSTRY

Figure 7. Cluster Concept Project Phase IV (cont'd), September 1968 - August 1969

	industrial education supervisor as inadequate (0) to adequate (10) for conducting a pilot program of the cluster concept.
School Administration	-The attitude of the administration of the school towards the cluster concept was rated by the industrial education supervisor as disinterested and uncooperative (0) to very interested and willing to cooperate (10).
Education	-Values were assigned to different levels of educational preparation of each teacher as follows: Vocational certificate - 2 Bachelors degree - 4 Bachelors degree plus thirty hours - 6 Masters degree - 8 Masters degree plus thirty hours - 10
Teaching Experience	-The number of years of teaching experience was equal to the value indicated on the profile up to a maximum of ten years.
Occupational Experience	-Credit for practical experience related to the cluster with which the teacher would work was granted with the number of years experience equal to the number on the profile up to a total or maximum of ten years.
Interview Results	-This was the total average rating received by the teacher on the interview schedule ratings (0-10)
Rokeach Results	-This was one-tenth of the percentile score received by the teacher on the Rokeach Test.

3. The Rokeach Dogmatism Scale was administered to the teachers to obtain an indication of an individual's cognitive rigidity and flexibility.
4. A panel of individuals, consisting of the county industrial education supervisors, the assistant

director of vocational education for Maryland, the principal investigator and the project coordinator reviewed the data collected for each prospective teacher and selected eleven teachers for participation in the program.

As a result of this procedure, eleven teachers were selected to receive special training in the cluster concept content and methods.

At the beginning of the Spring semester, 1967, the cluster concept teacher preparation program was initiated. The teachers observed an outlined schedule of attendance at the University of Maryland. The activities of the teacher preparation program during the Spring semester included: (1) development of instructional plans for implementing pilot programs; (2) acquainting teachers with instructional materials and equipment that may be used in the pilot programs; and (3) arranging the content for each cluster in an instructional sequence, including the areas of human requirement, as required by the specifications established in Phase I.

After careful study and research of the requirements for the cluster concept program, the teachers were evaluated on their competencies and needs. Teacher inadequacies were identified and programs were developed to meet these needs. These programs were carried out on and off-campus during the summer session beginning in June and ending in August of 1967.

In order to secure accurate and up-to-date technical training, industries and governmental organizations were used for establishing cooperating programs.

Some of the principal cooperating organizations were: Sylvania Electric Corporation, Westinghouse Electric Corporation, Tecnifax Corporation, Remington Rand Corporation, Associated Builders and Contractors, and the National Aeronautics and Space Administration.

Some of the activities engaged in at NASA are presented in Appendix A as news materials printed by this U. S government organization.

Final products of phase I and phase II included a teacher preparation curriculum which could be used by others as a guide for developing competent individuals to teach within a cluster concept program, curriculum materials, and instructional plans. These are all available from the officially designated ERIC Center for disseminating research information in the field of vocational-technical education.

Summary

The preceeding introduction was made to present the continuum of research performed prior to the implementation and evaluation stage, or phase III, which is reported in the following chapters.

The completion of phase I (identified as USOE Project Number OE-685-023), established the curriculum for the occupational clusters of Construction, Metal Forming and Fabrication, and Electro-Mechanical Installation and Repair. The completion of phase II (identified as USOE Project Number 6-2312), resulted in the production of curriculum guides, course outlines, instructional materials and the selection and training of the necessary teachers to implement the cluster concept programs in the four counties of the State of Maryland. Phase III (identified as USOE Project Number 7-0853), was concerned with the experimental evaluation and implementation aspects of the first year of the cluster concept program. The following pages contain the final report of phase III. Its major thrust is to provide new knowledge concerning: (1) the operation of the programs in a field setting, (2) the adequacy of the scope, sequence, and timing of the curriculum, (3) the effect on the student, teacher, and the school.

It is important to note that the cluster concept program was designed for the grades eleven and twelve. This report provides an evaluation of the eleventh grade program. Only by the completion of phase IV will the total effect of the new cluster concept program be properly observed and evaluated. The proposal for phase IV (as in all other phases) has been submitted to the U. S. Commissioner of Education for financial support through authorization of the Bureau of Research under the provisions of Section 4c of the 1963 Vocational Education Act.

PART II REPORT

THE STUDY OF THE EFFECT OF THE FIRST YEAR OF FIELD RESEARCH

Introduction

The following contents of this document (Parts II, III, and IV) form the main body of the final report required under the conditions of grant number OEG-0-8-000853-1865 (085) project number 7-0853. The duration of this grant included one year, from September 1, 1967 through August 31, 1968. The title which identifies this research is "The Implementation and Further Development of Experimental Cluster Concept Programs Through Actual Field Testing and Evaluation at the Secondary School Level." This research is also identified as phase III of the Cluster Concept Project.

This research was characterized as being "aexperimental" where several variables were investigated. As such, it was designed to generate various types of data. Descriptive, comparative, and quantitative data were obtained to assess the impact of the first year of the program on the school administration, teachers, students, and adequacy of the instructional materials.

Part II of this report included: (1) a presentation of an overall plan of the activities and problems of the study, and (2) completed research findings on the effect of the cluster concept programs on selected behavior of participating students.

Subsequent parts of this report are concerned with the evaluation of pedogogical and environmental factors.

Purposes and Problems

Problems Investigated

The problems investigated were those which provided evidence of the effectiveness of the cluster concept programs of studies in a field setting. The three principal areas of investigation included the determination of:

1. The impact of the cluster concept program on selected cognitive, and affective behaviors, and the task performances of students.
2. The adequacy and appropriateness of the content of the newly developed course and instructional materials.
3. The adequacy and appropriateness of administrative support, teacher effectiveness, and environmental conditions.

To investigate the first area of research mentioned above, pre and posttests, as presented in Table 1,were administered to control and experimental groups. The following cognitive changes of behavior were studied:

(a) The student's knowledge of the human requirements specified for the respective cluster program the student has pursued.

(b) The student's technical knowledge and task performance required in the occupational cluster in which he participated.

TABLE I

VARIABLES OF PRE AND POSTTESTS

Domain	Instruments	Factors Evaluated
Cognitive	Cluster Concept Achievement Test	Human Requirements* 1. Vocabulary 2. Measurement 3. Skills 4. Math and Science 5. Information
Cognitive	Mechanical Reasoning Differential Aptitude Test (The Psychological Corporation)	Applied science and mechanical reasoning
Affective	Minnesota Vocational Interest Inventory (The Psychological Corporation)	Interest patterns in relation to: 1. Carpentry field 2. Mechanical field 3. Electronics 4. Machinist 5. Painter 6. Plasterer 7. Sheet metal 8. Radio & TV
Cognitive	Occupational Information	Availability Status role Expectations Mobility

*Based on analysis of occupations, phase I and II.

(c) The student's achievement of knowledge related to the requirements, characteristics, and opportunities of occupational fields within the parameters of the cluster he was engaged in.

The affective changes were limited to selected vocational interests, vocational preferences, and aptitudes analyzed in terms of trends, shifts, and changes as empirically determined. The instruments used are outlined in Table 1.

This chapter or Part II of this report will be a further elaboration on the above principal area, whereas, areas 2 and 3 are presented in Part III.

The second area of investigation has been carried out to assure control and the proper functioning of the programs throughout the year. Feedback information gathered by the visiting research team into the schools operating programs provided descriptive data and a history of events recorded by the use of evaluative scales and anecdotal records. The various tasks that were structured into the cluster programs as expected behaviors of performance were used as an index to determine what has and has not been completed. All of these devices formed a criteria for evaluating instructional materials. This aspect of the study is presented in detail in Part III of this report.

The third area of investigation was concerned with the study of selected supportive dimensions, including the administrative behavior, material and moral support, physical facilities, and teacher effectiveness. These evaluations are presented in descriptive terms; also made, wherever appropriate, was an attempt to quantify certain categories of observed behaviors. Part III of this report contains the specific data, treatment, and discussion of this dimension of the study.

The Effect of the Cluster Concept Programs on Student Behaviors

To investigate the degree and nature of behavioral changes of students who studied within the cluster concept program, control and experimental groups were established. The experimental group completed one academic year of training in a cluster program taught by specially trained teachers. For the same interval of time a comparable group, the control group, pursued singular goal-directed vocational courses. Both groups were tested on a battery of pretests and posttests measuring the variables considered central to determining the effect of the experiences gained in the cluster programs. See Table 1. The initial administration of the battery was completed in September, 1967 and the final testing was completed in June, 1968. In the interim between these dates the experimental group and the control group studied within their respective courses. The participating teachers were instructed on the proper conduct and attitude to assume to avoid contamination of experimental variables by the "Hawthorne Effect."

Control variables were incorporated to assure continuous functioning of the programs and identification of comparable students. Scheduled visitations conducted by the research team and instruction materials served to keep the programs and activities on the proper course. Verbal or lingual ability and intelligence scores were obtained from school records to establish a reference point for comparability of the subjects. In several schools these were not available; however, intelligence scores were and these served to form a basis of comparability of students. This is to say that homogeneity of the students between students of the control and experimental group within each school was established either by verbal, lingual, or intelligence scores. No violence was done to the study since each school was analyzed independently. Each school was considered unique in terms of the type of student, cluster program, and community served.

The dependent and independent and control variables were identified. The treatment or the cluster concept program was the independent variable; whereas the factors evaluated by the tests presented in Table 1 are the dependent variables.

Problems Investigated

The problems investigated were those which provided evidence of the effectiveness of the cluster concept in a field setting. The main focus of the following material of Part II is directed on the investigation of the changes of behaviors of students on cognitive and affective variables. By investigating these, an indirect estimate of the adequacy and the effect of the cluster programs was obtained. This part of the report concerns itself with the learning activities, whereas Part III concentrates on teaching and other supportive activities.

The effectiveness of the learning process was evaluated in terms of (1) the magnitude of changes observed by data collected and (2) the number of students who have changed on the variables measured. Specific empirical evidence was sought to answer questions drawn up in a practical manner. The questions for the study of the cognitive behaviors of students were:

1. What were the differences, if any, between the experimental and control groups at the beginning of the study, on variables measured by the Mechanical Reasoning, verbal abilities and the cluster concept

achievement tests? Was there any evidence of differences found after one academic year of studies? What were the nature and magnitude of these differences?

2. Did the experiences from studying varied but related occupations facilitate an understanding of the cognitive skills required of students in a cluster program?
3. What supportive evidence was found to indicate that the cluster concept students gained knowledge appropriate to the expectations of the cluster programs?
4. Was there any significant difference in cognitive behaviors between the students of the traditional vocational education classes and the students of the cluster concept programs?
5. Was any statistical evidence found to verify whether the cluster programs facilitated growth in the variables of human requirements? What changes were observed on scores from the mechanical reasoning and cluster concept tests?
6. What generalizations can be advanced about the merits of the cluster concept programs as inferred from the data derived from student cognitive behaviors?

To investigate the merits of the cluster concept program on the basis of selected affective behaviors, answers to the specific questions were sought. These questions were:

1. Were the interests, as measured by the MVII of the students of both groups,in accord with the courses they chose to study?

2. At the end of the academic year, which group of students tended to change, shift, or extend their vocational preferences?
3. Does the cluster concept program facilitate changes of preferences within occupations of a cluster or occupations outside of the parameters of a cluster?
4. Were the changes of affective behaviors in accord with the objectives set forth for the cluster concept program?
5. What generalizations could be advanced regarding the changes of affective behaviors as displayed by the experimental group in relation to the control group?

Instruments Used

As in most cases where the need arises to evaluate a curriculum innovation, new tests must be developed. A thorough search of the available tests for various trades and occupations was completed. No test reviewed possessed the face or content validity suitable for the purposes of this study and as a result, the decision to construct a new instrument was made.

During phase II (1966-1967) the cluster concept teachers developed an expertise in the development of lesson plans for the occupations of a cluster During the first quarter of phase III these men submitted test items which they believed to reflect the cluster activities outlined in phase II. The cluster research staff reviewed and made an analysis of the items. The criteria used for building and reviewing the test items were:

1. The items must be based on the content of the level 1 cluster programs.

2. The items must require a student to solve a problem or apply knowledges or skills.
3. The items must be practical with verbalism held to a minimum.
4. The items should reflect the level 1 human requirements as outlined in the courses of study.
5. The items should be of the multiple-choice type adapted to machine scoring.
6. A comprehensive test for each cluster was required.

To obtain an estimate of the adequacy of the instruments, item analysis and Kuder-Richardson tests of reliability were completed. These tests are presented in the appendix; some pertinent data derived from investigating the performance of the tests is presented below.

TABLE 2

DATA AND RELIABILITY ESTIMATES OF CLUSTER CONCEPT TESTS

Cluster	Items	Subjects	Mean	S. D.	M. D.	Mode	r	r
Construction	86	53	30.72	13.81	36	26	.920*	.907**
Metal Forming and Fabrication	90	66	46.56	13.92	48	35	.912*	.894**
Electro-Mechanical	111	29	47.83	14.23	49	49	.900*	.876**

*Kuder-Richardson Formula 20
**Kuder Richardson Formula 21

Mechanical reasoning. The Mechanical Reasoning Test[1] which is a distinct and separate part of the D.A.T., produced by the Psychological Corporation, was administered to all groups as a pre and posttest measure. This test purports to distinguish those variables which enable persons to learn the principles of operation and repair of complex devices. Evidence was presented in the manual of the test that it has a good predictive ability for success in vocational subjects of study. The item content of this test closely reflected some of the knowledges required in the specified human requirements of the cluster concept program.

The purpose of using this test was twofold. In the event verbal or lingual scores were not available for all subjects, comparability would be established on this test as a criteria. Data from this instrument also provided an index for establishing an estimate of the effect of the cluster concept program on the development of knowledge from the fields of applied sciences and technology.

Vocational interests. The Minnesota Vocational Interest Inventory[2] was used by the cluster research project to attain an estimate of the degree of occupational change that took place in students in the course of the school year. The analysis included both the experimental and control groups, and was concerned with those occupations which are directly related to the cluster concept program.

The MVII, designed essentially to assess the occupational interests of persons at the non-professional level, places primary emphasis on persons who are seeking employment without having attended college. The inventory is intended to aid counselors working with students and others who are contemplating occupations at the skilled and semi-skilled levels.

---

[1] George K. Bennett, Harold G. Seashore, Alexander G. Wesman, Differential Aptitude Test - Mechanical Reasoning (Form A), Psychological Corporation, New York, 1947.

[2] David P. Campbell and Kenneth E. Clark, Minnesota Vocational Interest Inventory Manual, New York, Psychological Corporation, 1965, p. 8.

The literature related to the MVII reports that it has been administered at the ninth grade level and has been found that the students had no difficulty reading and understanding the items. The author of the MVII stated that this instrument was found suitable for persons of at least fifteen years of age, but the results should be viewed cautiously, since the occupational points of view change quickly between the ages of fifteen and twenty. Although evidence was not available, the author indicated that interests in occupations below the professional level seem to mature at an earlier age than do interests in professional activities.

Supplementary questionnaire. A questionnaire was developed to agument the MVII and to obtain a sample estimate of the changes of students' knowledge of occupational expectations. See Appendix B. The items were designed to elicit information from students with reference to their knowledge of job opportunities, geographic job mobility, promotional sequence, compensation, required training, job status, and changes due to advancing technology. These questions also reflected the understanding, on the part of the students, of the objectives and goals of the cluster concept programs.

Task inventory sheets. During phase II of the research complete course outlines and instructional materials for each cluster including specific performance tasks for level I and level II capability were developed. These tasks were all stated in exact behavioral terms. For a brief review of the procedures and analyses followed to accomplish the identification of tasks, reference should be made to Part I of this report or the final report of phase II. A compilation of the tasks for each cluster was made to form an inventory of the specific expectations of the course of studies. An inventory in a graphic format (See Part III) was used by the teacher as a progress chart and by the visiting research assistant as field progress charts to evaluate each school operation; copies were provided for students and parents, and in some instances, for employers.

Data obtained from these forms provided an objective basis for evaluating each cluster in a field setting and determined the adequacy of the scope, sequence, and timing of the curriculum. A separate task inventory sheet was made for each cluster since they are so diverse in their content.

Status survey of tools, materials, and equipment. To obtain an estimate of the effort expended in support of the cluster programs, survey forms were completed by the teachers. These forms elicited inventory information on the tools, materials, and equipment available at the beginning and at the end of the first year of operations. See Appendix C. The information gathered was used to help evaluate each school and was placed into a composite evaluating form.

Composite evaluation form. A composite technique was used to synthesize the evaluated variables of the instructional programs. Complex comparisons were objectified in a verbal and graphic manner. Further objectification was attained by using an index scale of numbers. These forms included an evaluation of administration, teacher, physical facilities, instruction and community involvement. See Part III.

Subjects. This research is confined to a population of boys who elected to study in traditional vocational education programs and in the cluster concept programs. The schools in which they pursued these programs were in four counties of the State of Maryland. At the beginning of the school year students comprising the experimental and control groups were entering the eleventh grade. Comparability of students within a school was achieved; however, differences on several variables between schools were evident. The obvious differences included: student background experiences, courses pursued in school prior to being included in the experiment, school environment, and industrial orientation of communities.

To avoid confounding the data due to uncontrollable variables the decision was made to evaluate each school independently. (See limitations of this study.) Homogeneity within a school between the experimental and control groups was achieved. In some schools verbal or lingual abilities were used; whereas, in others, I.Q. or mechanical reasoning was the basis for establishing comparability.

In Table 3 are codified data which obscure the name of the teacher and school and which present the number of students within each school. In some classes the number of subjects for which complete data was available was slightly lower than the enrollment in class. During the statistical treatment of data occasionally some cases were randomly dropped to expedite calculations. The number of subjects used for statistical investigation is presented in the discussion of the data in the following pages.

Limitations and assumptions. Within research studies which involve social groups, situations are encountered with uncontrollable variables, thereby creating a condition where ideal experimentation

TABLE 3

NUMBER OF SUBJECTS COMPLETING THE PROGRAMS

School	Teacher	Number of students cluster or experimental group	Number of students control group
		Construction Cluster	
A	108	15	17
H	101	16	12
D	102	16	7
C	106	14	11
	Totals	61	47
		Metal Fabrication Cluster	
B	110	17	17
E	105	16	10
F	111	12	8
J	104	15	10
	Totals	60	45
		Electro-Mechanical Cluster	
K	103	0	0
M	109	13	14
G	107	9	11
	Totals	22	25
	Grand Totals	143	117

conditions are not feasible. Full control of all the variables necessary for an ideal experiment was not achieved; therefore, this study was completed in the tradition of quasi-experimental design with the recognition of the points which would render the results equivocal. The imperfections, limitations, and assumptions included the following partially controlled or completely uncontrolled variables:

1. History of the students: the various combinations of stimuli which contributed to the development of the students prior to becoming a part of the experiment.
2. Maturation: the individual differences in ability to perform tasks due to natural development prior to and during the academic year of research.
3. Personality traits: the attitudes, interests, physical conditions, zeal, motivation on the part of the students, teacher, and administration.
4. Reactive arrangements: students perceive that they are in a different kind of a program and react emotionally in a variety of ways. The psychological disposition to take tests varies from student to student.
5. Restrictive sampling: the teachers who were selected and trained for the cluster program instructed both the experimental and control groups; intact classes were used; random assignment was not achieved.
6. Attendance: the effects of student and teacher observation, time of day, weather, season, and dropouts would not be controlled.
7. School factors: equipment, class size, general school

attitude toward vocational education were varied.

8. Extra school factors: home life and prevailing attitudes, travel, and parents' occupations.
9. Objectivity: the subjective evaluations of the visiting research teams to the field operations and the activities observed were time representative samples of the teaching-learning situation on days of no visitations.

Acknowledging the above limitations the quasi-experiment to assess the effectiveness of the cluster concept was implemented using the control, independent and dependent variables mentioned in the research design.

Presentation of Data and Findings

Selected Cognitive Variables

Vocational education courses, besides providing training in manipulative performance, must develop appropriate cognitive abilities and proper attitudes. The cognitive variables under investigation are those that are peculiar to the various occupations within the cluster concept programs. As previously described under the heading of instruments, the newly developed cluster tests were used to obtain an estimate of student growth in knowledges and in skills. The mechanical reasoning test which has been reported as a high predictor of success in technical occupations was also used to evaluate the growth of cognitive abilities derived from the applied sciences. The investigation of affective behaviors and performance of tasks are found in the latter part of this paper.

The presentation and discussion of the data and findings follow the order of considering each cluster and school independently. The problems presented in the previous pages were transformed to researchable hypotheses. The level of significance was set at the .05 level. The explanation or determination of the reasons for acceptance or rejection of hypotheses provided substance of information relevant to the effectiveness of the programs.

To avoid redundancy and to avoid repetition, four null hypotheses (hypotheses of no difference) applicable to all clusters and schools used in investigating the cognitive behaviors are stated below.

1. There was no statistical difference in achievement as measured by the cluster concept tests at the completion of the experiment among eleventh grade boys who studied in the cluster concept program and those who studied in the traditional vocational education program.
2. There were no statistical differences in achievement by the control or the experimental group as determined on pre and posttests measuring knowledge required for the cluster program.
3. There were no statistical differences in mechanical reasoning ability scores at the completion of the experiment among eleventh grade boys who studied in the cluster concept program and those who studied in the traditional yet similar vocational education program.
4. There were no statistical differences in achievement by the control or the experimental group as determined on pre and posttests measuring mechanical reasoning abilities.

Figure 8 is a graphic representation of the operations conducted to generate data which are presented within the following pages. The evaluation of each school is presented independently.

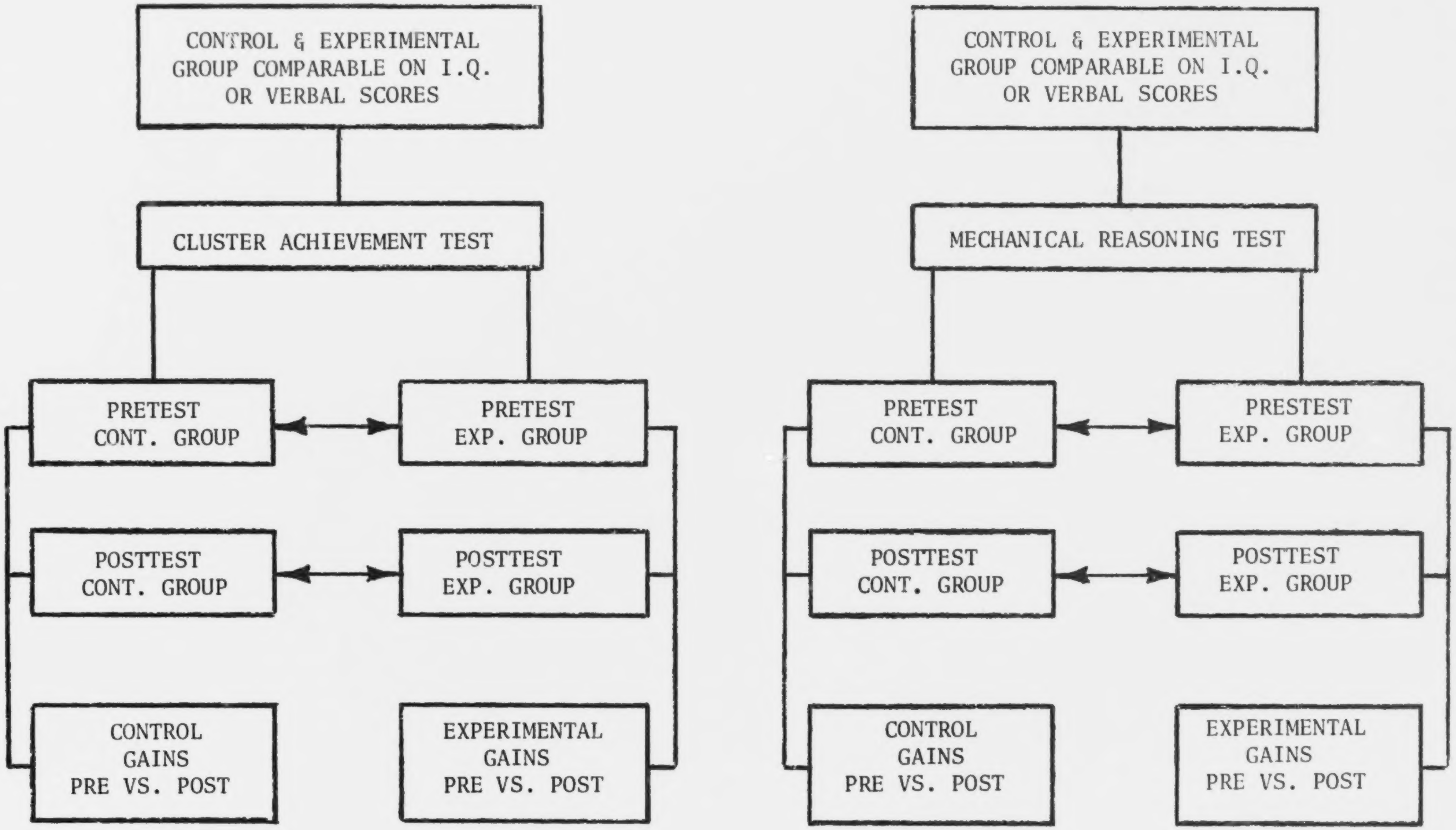

CONTROL & EXPERIMENTAL GROUP COMPARABLE ON I.Q. OR VERBAL SCORES
CLUSTER ACHIEVEMENT TEST
PRETEST CONT. GROUP
PRETEST EXP. GROUP
POSTTEST CONT. GROUP
POSTTEST EXP. GROUP
CONTROL GAINS PRE VS. POST
EXPERIMENTAL GAINS PRE VS. POST
CONTROL & EXPERIMENTAL GROUP COMPARABLE ON I.Q. OR VERBAL SCORES
MECHANICAL REASONING TEST
PRETEST CONT. GROUP
PRESTEST EXP. GROUP
POSTTEST CONT. GROUP
POSTTEST EXP. GROUP
CONTROL GAINS PRE VS. POST
EXPERIMENTAL GAINS PRE VS. POST

Figure 8. Syntagma of Operations Resolving Hypotheses

TREATMENT OF DATA AND FINDINGS

The remainder of Part II of this report deals with the data and findings based on cognitive and affective changes of behaviors in students from which inferences were made about the effectiveness of the programs. These are but two aspects of the evaluation and do not enable a comprehensive assessment of the effectiveness of the programs as they were implemented in the field. Due to the many diverse variables impinging upon the pilot programs, the decision was made to evaluate each school operation independently with due consideration of non-experimental events to include descriptive information about the administration, the teacher, the instruction, physical facilities and the community. These are included in Part III of this report.

School A. The four schools which were involved in implementing the construction cluster were randomly coded for anonymity. For the purposes of this report they were identified as School A, C, D and H. More detailed information about the characteristic of these schools and salient activities of the programs are reported in Part III.

The specially trained teacher taught the cluster program and traditional vocational education program or industrial arts program. One aspect of his training included an understanding of the proper conduct and procedure to observe while conducting classes for research purposes.

Comparability of groups. At the outset, data derived from both groups were investigated to obtain an estimate of statistical comparability of subjects on the basis of intelligence test scores. Originally it was intended to use verbal or lingual abilities as a basis for homogeneity. However, a number of reasons for the inability to obtain this type of data emerged.

Prior to determining whether the samples were comparable on I.Q., the F max test for samples of equal size (intact groups) was used to determine if homogeneity of variances existed. Table 5 presents the group mean I.Q. for the experimental groups, 99.267, and the mean for the control group as 93.867. The observed F max value of 2.06 was lower than the table value of 2.86 required for significance beyond the .05 level. See Table 4. These data were taken as evidence to support the statement that the two samples came from the same population.

To test whether the two groups differed significantly on the basis of intelligence scores, the analysis of variance was used. An F ratio of 2.251 was observed. See Table 9. This value was less than the table value of F 4.20 required for significance at the .05 level with one and twenty-eight degrees of freedom. With the support of these findings the judgement was made that both groups were comparable, or not significantly different,on the abilities measured by intelligence tests.

Initial differences on achievement. Both groups were tested on a pretest cluster concept instrument. There was reason to believe that the students forming the control group would have a decided advantage over the subjects of the experimental group. The difference, it was assumed, would be due to the greater exposure of shop experience which the control group had. A construction cluster test was administered to both groups. See Appendix E. By calculating an F max (See Table 6) for homogeneity of variance and then proceeding with the analysis of variance, an F ratio of 8.248 (See Table 8) was observed. Table 7 presents the data indicating that the control group scored a group mean of 21.467 and the experimental group a mean of 29.067. These data indicated that the experimental or cluster concept group initially scored significantly higher scores on the cluster achievement test over the control group. The null hypothesis of no significant difference was rejected. Stated differently, at the beginning of the study the experimental and control groups varied on the estimates of cognitive abilities required in the cluster program but were homogeneous on the basis of I.Q.

Final differences on achievement. Posttest scores estimating the abilities of students from both groups yielded a mean of 44.467 for the experimental group and a mean of 21.933 for the control group. See Table 7. The analysis of variance was used to test the hypothesis of no significant difference. An F ratio of 28.689 was observed (See Table 8), thus the null hypothesis (number one) as stated was rejected and the alternate hypothesis that there was a significant difference was accepted.

The omega square statistic for estimating the treatment effects was observed to be .48. See Table 30. This estimate indicated that 48 percent of the variance between the experimental and control group scores was accounted for by the treatment effects.

Gains on achievement. The analysis of variance statistic was used to test the hypothesis of no difference between the pre and posttest measures evaluating abilities of the construction cluster test. This was done for both groups. Table 7 exhibits the mean for the pretest and posttest of the control and experimental groups. The mean for the control group was 21.467, the posttest mean was 21.933. It was evident that the control group made no significant gain between the pretest and posttest scores as measured. The experimental group scored a mean of 29.067 on the pretest and a mean of 44.467 on the posttest. The analysis of variance statistic yielded an F ratio of 10.974. See Table 10.

The null hypothesis (number two) of no significant differences, as stated, was rejected and the alternate hypothesis was accepted.

Summary statement on achievement for School A. The findings of the study, as related only to School A, support the hypothesis that the construction cluster program had a significant effect on the behavior of the subjects. The difference was observed by data generated from the construction cluster test which provided scores estimating achievement. On the basis of the data, the control group displayed an arrested level of abilities as measured by the construction cluster test. This test included items from the fields of plumbing, carpentry, painting, electricity, and masonry. The control group studied with different goals and objectives, consequently, it was not exposed to a systematic and comprehensive study of these fields. Accordingly, the results were considered as describing a reasonable occurrence since both programs of study differ in objectives and content.

The differences were taken to indicate that the experimental group was moving in the direction of achieving the goals and objectives of the construction cluster concerned with cognitive development. Part III of this report includes an evaluation of student task performances.

School C. This school was one of four implementing the construction cluster program. A review of the evaluations for this school (Part III) on the variables of administrative support, instruction, teacher, physical facilities, and community involvement provide the data which distinguish this school as being unique and as such this school and others are evaluated independently. The following statistical evaluations of student behaviors are confined to the two sample groups within School C.

Comparability of groups. The number of subjects which completed the cluster program was 14. See Table 1. Due to the limited data from subjects of the control group statistical analysis was conducted with twelve subjects in each group. Comparability of the groups was tested in the same manner as described for School A. The condition of the homogeneity of variances was established. See Table 4. To determine if any significant difference between the groups existed on the basis of intelligence scores, the analysis of variance statistic was used. The mean I.Q. for the control group was 91.584, and for the experiment group the mean was 89.500. See Table 5. The observed F ratio was .124 or less than 1.00 which indicated non-significant differences. These findings indicated that the two groups were similar on the basis of intelligence scores.

Initial differences on achievement. The construction cluster test was administered to both groups in School C to determine the level of the students' knowledge at the beginning of the experiment. This was done by treating the data with the analysis of variance for investigating whether significant difference existed between the two groups. Table 6 presents the data indicating that homogeneity of variance existed, and Table 7 presents the mean and standard deviations for both groups. Table 8 presents the F ratio of 3.802 which was lower than the table value required for significance at .05 level. Accordingly, the null hypotheses of no significant difference was accepted. Stated in another way, both groups were comparable on the basis of I.Q. and construction cluster knowledges at the beginning of the experiment.

Final differences on achievement. Posttest data estimating achievement obtained from School C enabled the generation of a mean of 28.929 for the experimental group and a mean of 21.929 for the control group. See Table 7. The analysis of variance was used to test the null hypothesis (hypothesis one) that there was no significant difference between the data derived from both groups on the posttest of achievement. An F ratio of 8.099 was observed. See Table 8. This was greater than the table value of F 7.94 required for significance at the .01 level. Thus, the null hypothesis (number one) as stated was rejected and the alternate hypothesis was accepted.

The omega square statistic for estimating the treatment effects was observed to be .23. See Table 30. This estimate indicated that 23 percent of the variance between the experimental and control group scores was accounted for by the treatment effects.

Gains on achievement. Data were gathered to determine if any growth had taken place between the time the pretest and posttest were administered. Data derived from test scores were treated by the analysis of variance statistic. A pretest mean of 21.571 and a posttest mean of 28.929 was calculated for the experimental group. See Table 7. After completing the analysis of variance to test for differences an F of 6.121 was observed for the experimental group. See Table 11. The table of F required for significance at the .05 level is 4.30. Thus, the hypothesis of no significant difference between pretest and posttest scores was rejected. Hypothesis two, as stated, was rejected and the alternate hypothesis of a significant difference was accepted.

The control group means observed were 20.563 and 21.929, respectively. Treating the data with the analysis of variance an F ratio of .047 was observed. See Table 11. Since this value was less than 1.00, the null hypothesis as stated was accepted.

Summary statement on achievement for School C. The subjects of School C were observed to be comparable on intelligence scores and initial achievement abilities. At the end of the school year both groups differed significantly from each other on achievement test scores. This was taken as supportive evidence that the construction cluster course of study as operated in this school did have an effect on the cognitive abilities of the subjects. Accordingly, the program was moving in the direction of meeting the cognitive objectives of the construction cluster. This was further supported by the findings which indicated that the control group did not achieve significant changes. This was attributed to the different objectives and goals which form the basis for both programs.

School D. Reference to Part III will provide the reader with the description of the conditions and psychosocial variables which impinged upon the operations at School D. This school was implementing the construction and metal forming and fabrication cluster programs.

Comparability of groups. The subjects of both groups were characterized as being below average in verbal abilities as measured by the Lorge-Thorndike Intelligence Test. Subtest scores were converted to "z" scores. The control group scored a z score mean of -.89, whereas the experimental group scored a mean of -1.05. See Table 5.

Comparison of the data derived from the initial construction cluster achievement test included an observed mean of 25.077 for the control group and a mean of 23.539 for the experimental group. See Table 7. Homogeneity of variance was investigated prior to treating the data with the analysis of variance. See Table 6. The observed F ratio was .249. See Table 12. Since this F was less than 1.00, this was an indication of no significant difference. Stated in other words, both groups were comparable on estimate of abilities measured by the construction cluster test at the beginning of the experiment.

Final differences on achievement. Estimate of achievement obtained from posttest scores, from both groups, at the end of the academic year yielded a mean of 32.077 for the experimental group and a mean of 23.538 for the control group. See Table 7. To test the hypothesis of no significant difference (hypothesis one) between the data generated by both groups the analysis of variance was used. See Table 12. An F ratio of 4.407 was observed. For one and twenty-four degrees of freedom a table value of F 4.26 must be exceeded for rejection at the .05 level. Accordingly, the decision was made to reject the null hypothesis as stated. The alternate hypothesis that the experimental group made significantly higher scores than the control group was accepted.

The omega square statistic for estimating the treatment effects was observed to be .12. See Table 30. This estimate indicated that 12 percent of the variance between the experimental and control group scores were accounted for by the treatment effects.

Gains on achievement. The analysis of variance statistic, testing if there were significant differences between the pre and posttest scores generated by each group, was performed. The experimental group had a mean of 23.538 on the pretest and a mean of 32.077 on the posttest. See Table 7. The observed F ratio was 5.05. See Table 10. This finding provided the evidence for rejecting the null hypothesis (number two) as stated and accepting the alternate hypothesis supporting a significant difference.

The pretest mean for the control group was 25.077 and for the posttest it was 23.538. The data was not treated any further due to the observation that there was a slight decrease in the means on the posttest.

Summary statement on achievement for School D. The subjects of School D, of both groups, were characterized as being below average in verbal abilities. The data generated, which were statistically tested, provided evidence that the subjects of the construction cluster did demonstrate significantly higher scores than the control group, and, also, that they made significant gains. The inference was made that the construction cluster program in this school was effective in the development of the cognitive variables required in the vocations of carpentry, electricity, masonry, painting and plumbing. This effectiveness was not taken to demonstrate that the program was without problems and shortcoming. Part III of this report presents a further analysis of the operations conducted at this school.

School H. This school was the fourth implementing the construction cluster program. A review of the evaluations for this school on the variables of administrative support, instruction, teacher, physical facilities, and community involvement provide the data which must be considered to appreciate the numerous problems impinging upon the operation of the pilot program.

Comparability of groups. Comparability of the control and experimental groups was tested on the basis of intelligence test scores in the same manner as described for School A. Applying the F max test for homogeneity of variance, a value of 1.74 was observed. See Table 4. To determine if any significant difference between the groups existed, the analysis of variance was used. The calculated mean I.Q. for the control group was 93.867, and for the experimental group the mean was 87.934. See Table 5. The observed F ratio was 1.471 which indicated non-significant differences between the groups on the basis of scores derived from the intelligence tests. See Table 9.

Initial differences on achievement. The newly developed construction cluster test was administered to both groups in School H to determine the level of the students' knowledge at the beginning of the experiment. This was done by treating the data with the analysis of variance for investigating whether significant differences existed between the two groups. Table 6 presents the F max of 1.361, indicating that homogeneity of variances was observed. Table 7 presents the mean and standard deviations obtained for both groups. Table 12 presents the F ratio of .809 derived from the treatment of the data with the analysis of variance. Since the F ratio found was less than 1.00, it was evident that there was no significant difference between the groups on the initial construction cluster test.

Final differences on achievement. Quantitative data obtained from School H at the end of the school year included a mean of 24.867 for the experimental group and a mean of 21.933 for the control group. See Table 7. The analysis of variance was used to test the hypothesis (hypothesis one) that there was no significant difference between the data derived from both groups on the posttest of achievement. An F ratio of 2.694 was observed. See Table 12. A table of F for significance at the .05 level requires a value of 4.20. Thus, the null hypothesis as stated (number one) was accepted. See Table 30.

Gains on achievement. Data from initial tests and final tests were gathered to determine if any change in cognitive behavior had taken place.

The data were treated by the analysis of variance statistic. A pretest mean of 23.533 and a posttest mean of 24.867 was observed for the experimental group. See Table 7. After completing the analysis of variance to test for differences, an F of 5.01 was observed. See Table 11. The table value of F required for the .05 level for one and twenty-eight degrees of freedom is 4.20. The null hypothesis as stated (hypothesis two) was rejected.

The observed control group means were 21.667 and 21.933 for the pretest and posttest,respectively. Treating the data with analysis of variance, an F ratio of .071 was observed. See Table 11. Since this value was less than 1.00, the null hypothesis was accepted.

Summary statement on achievement for School H. The subjects of School H were observed to be comparable on intelligence scores and initial achievement abilities. At the end of the school year both groups were not significantly different from each other on the achievement test scores. However, the experimental group made significant gains when its pretest scores were studied in relation to the posttest scores. Of the four schools implementing the construction cluster, this was the only school which did not demonstrate superior performance over the control group. This was taken to indicate that the cluster program at this school was not meeting the cognitive objectives and goals. From these findings it was recommended that cognitive development must become a deliberate objective. Other variables which contributed to the shortcomings at School H are presented in Part III.

Since several aspects of this operation were found wanting, many suggestions for improvement are presented in Part IV of this report.

Metal Forming and Fabrication Cluster

The metal forming and fabrication cluster program was implemented in four distinct field operations. For the purpose of anonymity the operations were coded as School B, E, D, and J. Within each school specially trained teachers taught a cluster program and a traditional vocational education program or an industrial arts program.

A review of the related materials found in Part III provides the reader with the evaluation of and an understanding of the conditions and psychosocial variables which impinged upon the operations of each of the schools.

School B. At the completion of the experiment, seventeen students formed the cluster group. Since there were fifteen students for whom there were complete data, the number of subjects used in statistical treatment was fifteen for the experimental group and fifteen for the control group.

Comparability of groups. Comparability of the experimental and control groups was established in the same manner as described for School A. The required condition of homogeneity of variance was met. See Table 4 for the observed F max. To determine if any significant difference between the groups existed on the basis of intelligence scores, the analysis of variance was employed. The mean intelligence score for the control group was 101.375 and for the experimental group the mean was 95.438. See Table 5. The observed F ratio obtained by testing for no significant difference between the groups was 1.812. See Table 15. This value was less than the table value of F 4.17 required for significance at the .05 level with one and thirty degrees of freedom. Accordingly, the judgement was made to accept the difference between the groups as insignificant. Stated in another manner, the groups were comparable on the scores derived from intelligence tests.

Initial differences on achievement. The metal forming and fabrication test was administered to both groups of School B to obtain an estimate of the level of the students' knowledge at the beginning of the experiment. The data gathered were treated with the analysis of variance for purposes of investigating if a significant difference existed between the abilities of the two groups. Table 6 presents the data indicating that homogeneity of variance existed. An F max 1.238 was observed. Table 7 presents the mean and standard deviations calculated for both groups. Table 13 presents the observed F ratio of 2.359 which was lower than the table value required for significance at the .05 level. Accordingly, the null hypothesis of no significant difference was accepted. Stated in other words, evidence was found to ascertain that the two groups were comparable on the basis of intelligence test scores and also on estimates of metal forming and fabrication cognitive abilities.

Final differences on achievement. From School B the posttest data gathered yielded a mean of 45.312 for the experimental group and a mean of 37.062 for the control group. See Table 7. The analysis of variance was used to test the hypothesis (hypothesis one) that there were no significant differences between the data derived from both groups on the posttest of achievement. An F ratio of 4.236 was observed. See Table 13. This was greater than the table value of F 4.17 required for significance at the .05 level. Accordingly, the null hypothesis as stated (number one) was rejected and the alternate hypothesis was accepted.

The omega square statistic for estimating the treatment effects was observed to be .09. See Table 30. This estimate indicated that 9 percent of the variance between the experimental and control group scores were accounted for by the treatment effects.

Gains on achievement. Data estimating achievement were gathered to determine if any growth had taken place in the interim between the pretest and posttest. Data derived from the tests were treated by the analysis of variance statistic. A pretest mean of 44.250 and a posttest mean of 50.312 was observed for the experimental group. See Table 7. The analysis of variance statistic yielded an F ratio of 7.110. See Table 14. The table value of F required for significance at the .05 level is 4.17. Accordingly, the hypothesis of no significant difference (hypothesis number two) between the pretest and posttest was rejected.

The control group means for the pretest and posttest were 39.062 and 37.062 respectively. Since the mean was lower on the posttest it was obvious that growth had not taken place. However, a check was made to determine if the drop in the means was significant. The analysis of variance treatment yielded an F of .370. See Table 14. Since this value was less than one, no significant difference was observed.

Summary statement on achievement for School B. The subjects of School B were observed to be comparable on estimates of intelligence and initial cognitive abilities as measured by the metal fabrication cluster test. At the end of the school year both groups differed significantly from each other on achievement test scores. This was taken as supportive evidence that the metal forming and fabrication cluster program, as conducted in this school, did have an effect on the cognitive abilities of the subjects and did implement the goals and objectives. By virtue of not having the varied experiences of the cluster program, the control group did not achieve significant gains.

This further reinforced the finding that the cluster program was moving toward different objectives than those followed by the traditional program.

School E. At the completion of the experiment seventeen students formed the cluster group. Since there were sixteen students for which there was complete data, the number of subjects used in statistical treatment was sixteen for the experimental group and sixteen for the control group.

Comparability of groups. Comparability of the experimental and control groups was established in the same manner as described for School A. The required condition of homogeneity of variance was met. See Table 4 for the observed F max. To determine if any significant difference between the groups existed on the basis of intelligence scores, the analysis of variance statistic was employed. The mean intelligence score for the control group was 100.40 and for the experimental group the mean was 104.20. See Table 5. The observed F ratio obtained by testing for significant difference between the groups was .748. See Table 15. The observed ratio by virtue of being less than 1.00 indicated non-significant difference. These findings were taken as evidence that the two groups were comparable on the scores derived from intelligence tests.

Initial differences on achievement. The metal forming and fabrication test was administered to both groups of School E to obtain an estimate of the level of the students' knowledge at the beginning of the experiment. The obtained data was treated with the analysis of variance for purposes of investigating if a significant difference existed between abilities of the two groups. Table 6 presents the data indicating that homogeneity of variance existed. An F of 2.764 was observed. Table 7 presents the mean and standard deviations for both groups. Table 16 presents the observed F ratio of .127 which was less than 1.00 and indicated non-significant differences. Accordingly, the null hypothesis of no significant difference was accepted. Stated differently, both groups were comparable on the basis of intelligence test scores and the scores derived from the metal forming and fabrication cluster achievement test.

Final differences on achievement. Posttest data gathered from subjects of both groups in School E yielded a mean of 45.625 for the experimental group and a mean of 37.062 for the control group. See Table 7. The analysis of variance was used to test the hypothesis (hypothesis one) that there were no significant differences between the data derived from both groups on the posttest of achievement. An F ratio of 5.727 was observed. See Table 16. This was greater than the table value of F 4.17 required for significance at the .05 level. Accordingly, the hypothesis (hypothesis one) was rejected and the alternate hypothesis of a significant difference was accepted.

The omega square statistic for estimating the treatment effects was observed to be .13. See Table 30. This estimate indicated that 13 percent of the variance between the experimental and control group scores was accounted for by the treatment effects.

Gains on achievement. Data were gathered to obtain an estimate of the growth (if any) that had taken place in the interim between the pretest and posttest. Data derived from the tests were treated by the analysis of variance statistic. A pretest mean of 37.500 and a posttest mean of 45.625 were observed for the experimental group. See Table 7.

The analysis of variance statistic yielded an F ratio of 6.240. See Table 17. The table value of F required for significance at the

.05 level is 4.17. Accordingly, the hypothesis of no significant difference (null hypothesis number two) between the pretest and posttest was rejected.

The control group means for the pretest and posttest were 39.062 and 37.062 respectively. This same group was used as a control with the experimental group of School B. Since the mean was lower on the posttest it was obvious that growth had not taken place. However, a check was made to determine if the drop in the means was significant. The analysis of variance treatment yielded an F of .370. See Table 14. Since this value was less than one, no significant difference was observed.

Summary statement on achievement for School E. The subjects of School E were observed to be comparable on intelligence scores and initial cognitive abilities as measured by the metal forming and fabrication cluster test. At the end of the school year both groups differed significantly from each other on achievement test scores. The test estimated cognitive abilities in welding, machining, sheet metal and assembly. The control group studied under different goals and objectives; accordingly, the expectations were to observe a divergence in performance if the cluster program was functioning. Accordingly, the evidence indicated that the program, as operated in School E, was effective in implementing the cognitive abilities of students required in the cluster program.

This was one aspect of the evaluation of the program. Part III includes the other variables of the program which dictate improvements and refinements.

School D - Teacher F. Fifteen subjects formed the experimental group and only eight in the control group. To equalize the number, data from seven subjects, drawn randomly from School B, were assigned to the control group.

Comparability of groups. The subjects of both groups were noticeably below average in verbal abilities as measured by the Lorge-Thorndike Intelligence Test. Subtest scores were converted to "z" scores. The control group scored a "z" score mean of -.58, whereas, the experimental group scored a mean of -.84. See Table 15. Comparisons based on the data derived from the initial metal forming and fabrication test included a derived mean of 35.267 for the control group and a mean of 40.533 for the experimental group. See Table 7. Prior to treating the data with the analysis of variance, homogeneity of variance was tested. An F max of 2.648 was observed. See Table 6. The F Ratio of 1.855 derived from testing the hypothesis of no significant difference between the groups on scores derived from the pretest was found to be much lower than the table value of F 4.20. See Table 16. With the support of these findings, the judgement was made that both groups were comparable or that no significant differences existed between the groups on the abilities measured by the metal forming and fabrication cluster test.

Final differences on achievement. Data gathered on the first test from the subjects of both groups in School D yielded a mean of 49.867 and a mean of 38.333 for the control group. See Table 7.

The analysis of variance was used to test the null hypothesis (hypothesis one) that there were no significant differences between the data derived from both groups on the posttest of achievement. An F ratio of 12.498 was observed. See Table 16. This value was greater than the table value of F 7.64 required for significance at the .01 level. Accordingly, the null hypothesis as stated (number one) was rejected and the alternate hypothesis of significant difference was accepted.

The omega square statistic for estimating the treatment effects was observed to be .28. See Table 30. This estimate indicated that 28 percent of the variance between the experimental and control group scores were accounted for by the treatment effects.

Gains on achievement. Data were gathered to determine if any growth had taken place in the interim of time between the pretest and posttest. Data derived from the tests were treated by the analysis of variance statistic after testing the variances for homogeneity. A pretest mean of 40.533 and a posttest mean of 49.867 was derived for the experimental group. See Table 7. The analysis of variance applied to this data yielded an F ratio of 5.626. See Table 14. The table of F value required for significance at the .05 level is 4.17. Accordingly, the hypothesis of no significant difference (hypothesis number two) between the pretest and the posttest was rejected.

The control group means for the pretest and posttest were 35.267 and 38.333 respectively. See Table 7. Treating the data with the analysis of variance, an F ratio of .930 was observed. See Table 14. Since this value is less than 1.00, the null hypothesis of no significant differences was accepted.

Summary statement on achievement for School D. The subjects of School D were observed to be below average in verbal abilities as measured on an intelligence test. They were comparable on initial estimates of cognitive abilities as measured by the metal fabrication cluster test. At the end of the school year both groups differed from each other significantly on scores from this test. It was concluded that the metal forming and fabrication cluster program, as conducted in this school, did have an effect on the cognitive abilities of the subjects.

The test included items from the occupations of assembly, machining, sheet metal and welding. Since the control group did not have experience in all of these fields, they remained at an arrested level on the variables measured by the test. This indicated that both groups were following different goals and that the divergence of performance on the tests provided evidence that the cluster program was meeting the objectives related to the development of cognitive abilities. While this evidence was favorable, reference to Part III of this report discloses some of the shortcomings which dictate the needs of Teacher F's program at School D.

School J. Complete data were available for fifteen of the subjects which participated in the metal fabrication cluster program and for fifteen subjects of an industrial arts general metals shop which was used as a control group.

Comparability of groups. Comparability of the experimental and control groups was established in the same manner as described for School A. The required condition of homogeneity of variance was met. See Table 4 for the observed F max of 1.22. To determine if any significant difference between the groups existed on the basis of intelligence scores, the analysis of variance was employed. The mean intelligence score for the control group was 100.400 and for the experimental group the mean was 100.200. See Table 5. The observed F ratio obtained by testing for no significant difference on intelligence test scores between the groups was .003. See Table 15. By virtue of being less than 1.00, the observed ratio indicated non-significant differences. The above two findings were taken as evidence that the two groups were comparable on the scores derived from intelligence tests.

Initial differences on achievement. The metal forming and fabrication test was administered to both groups of School J to obtain an estimate of the level of the students' knowledge at the beginning of the experiment. The obtained data were treated with the analysis of variance for purposes of investigating if a significant difference existed between abilities of the two groups. Table 6 presents the data indicating that homogeniety of variance existed , F max 1.659. Table 7 presents the mean and standard deviations for both groups. Table 13 presents the observed F ratio of 6.351 which was larger than the table value of F 4.20 required for significance at the .05 level with one and twenty-eight degrees of freedom. Accordingly, the null hypothesis of no significant difference was rejected and the alternate hypothesis that there was a significant difference was accepted. This difference was in favor of the experimental group, hence, the two groups were not initially equivalent on the cognitive abilities of the metal forming cluster test.

Final differences on achievement. Posttest data gathered from the subjects of both groups in School J yielded a mean of 57.000 for the experimental group and a mean of 44.066 for the control group. See Table 7.

The analysis of variance was used to test the null hypothesis (hypothesis one) that there were no significant differences between the data derived from both groups on the posttest of achievement. An F ratio of 11.705 was observed. See Table 13. This was greater than the table value of F 7.64 required for significance at the .01 level. Accordingly, the null hypothesis as stated (hypothesis number one) was rejected and the alternate hypothesis was accepted.

The omega square statistic for estimating the treatment effects was observed to be .36. See Table 30. This estimate indicated that

36 percent of the variance between the experimental and control group scores was accounted for by the treatment effects.

Gains on achievement. To determine if any growth has taken place in the interim between the pretest and posttest, the gathered data were treated by the analysis of variance statistic. A pretest mean of 49.867 and a posttest mean of 57.000 was observed for the experimental group. See Table 7.

The analysis of variance statistic yielded an F ratio of 4.480. See Table 17. The table value of F required for significance at the .05 level is 4.17. Accordingly, the null hypothesis of no significant difference (hypothesis number two) between the pretest and posttest was rejected.

The control group means for the pretest and posttest were 40.600 and 44.066 respectively. See Table 7. Treating the data with the analysis of variance statistic an F ratio of .731 was observed. See Table 17. Since this value was less than 1.00, the null hypothesis of no significant difference was accepted.

Summary statement on achievement for School J. The subjects of School J were observed to be comparable on intelligence test scores but differed on initial abilities measured by the metals cluster test. The difference was to the advantage of the experimental group. At the end of the school year both groups differed from each other on scores of achievement. Also at the end of the term the experimental group achieved significant gains over their initial scores, whereas, the control group tended to remain at a stable level. Since the experimental group performed more in accord with the cognitive objectives of the cluster program, it was inferred that the program at School J was effective.

While the data indicated effectiveness on this one research variable, it is not to be assumed that optimum effectiveness was achieved. Part III provides the evaluation and description of the many impediments which, if removed, could aid in a substantially improved operation at School J.

Electro-Mechanical Cluster

The electro-mechanical cluster was implemented in two field operations. For purposes of anonymity the operations were coded as School G and M. Within each school specially trained teachers taught a cluster program and a traditional vocational education program.

A review of descriptive data found in Part III provides the reader with the evaluation of, and information for the understanding of the conditions and psychosocial variables which impinged upon the operations of each of the schools.

The analysis of variance was the principal statistical technique used in analyzing the research data from the construction and metal forming and fabrication clusters. However, the Mann-Whitney U-Test was used to analyze the electro-mechanical data because it became evident that these data did not meet all assumptions of the anlaysis of variance technique (F-ratio). A serious limitation of these data was the size of the treatment groups in this cluster. These sample sizes were relatively small, so small as to yield a questionable F-statistic.

The Mann-Whitney U-Test, when used with small samples, is more appropriate than the F-test and more powerful than the median test. (Power being the probability of rejecting the null hypothesis when it is, in fact, false). This non-parametric test employs two independent samples, small samples, and measurements which need be only of an ordinal scale.

School G. At the completion of the first year of this experiment, nine students comprised the cluster group. Since there were two students for which complete data was not available, the number of subjects used in the statistical analysis were seven in the experimental group and seven in the control group. Data were not available for a control group at this school, therefore, control group data was secured from the control group in the electro-mechanical cluster at School M. The process by which the control group was selected is further described in the section dealing with School M.

Comparability of groups. Since intelligence data were not available for the students in the electro-mechanical cluster, these students were equated on similarity of programs studied and on mechanical reasoning scores. The mean mechanical reasoning score for the experimental and control groups was 29.00 and 39.214, respectively. A test for significant difference in mechanical reasoning scores between the two groups yielded a Mann-Whitney U-Test z value of 1.214. See table 28. This value was less than the value of z required for the rejection of the null hypothesis that there would be no significant differences in the mechanical reasoning scores of the two treatment groups. Accordingly, the judgement was made to accept the differences between the groups as insignificant. Thus, the groups were comparable on the scores derived from mechanical reasoning test.

Initial difference on achievement. The electro-mechanical achievement test was administered to both the experimental and control groups of School G to determine the level of student knowledge at the beginning of the experiment. Mean scores for the two groups were 41.143 and 54.143, respectively. The obtained data were treated with the Mann-Whitney U-Test for purposes of determining if significant differences existed between the initial achievement of the two groups. Table 28 presents an observed z of 1.023 which was lower than the z value necessary for the rejection of the null hypothesis that there were no significant differences between the two groups in initial achievement as measured by the electro-mechanical achievement test. Accordingly, the null hypothesis was retained since evidence was found to ascertain that the two groups were alike on scores derived from the electro-mechanical cognitive abilities test.

Final differences on achievement. Scores estimating achievement gathered from School G produced a mean of 50.428 for the experimental group and a mean of 54.857 for the control group. See Table 7. The Mann-Whitney U-Test was employed as the statistical technique to test the research hypothesis that there were significant differences between the data derived from the groups on the posttests of achievement. A z of .064 was obtained. See Table 28. This was less than the z value necessary to reject the null hypothesis. Accordingly, the data did not support the research hypothesis.

Gains on achievement. Quantitative data were gathered to determine if any growth had taken place in the interim between the pretest and posttest. Again the statistical technique utilized was the Mann-Whitney U-Test. A pretest mean of 41.143 and a posttest mean of 40.428 was observed for the experimental group. See Table 7. The Mann-Whitney U-Test yielded a z of 1.340 which led to the retention of the null hypothesis that there were no significant differences in the gains in achievement from pretest to posttest.

The control group means for the pretest and posttest were 54.143 and 54.857, respectively. The utilization of the Mann-Whitney U-Test yielded a z value of 1.023. This was less than the z value necessary to reject the null hypothesis that there would be no significant differences in gains in achievement. See Table 29.

Summary statement on achievement for School G. The subjects of School G were observed to be comparable on mechanical reasoning scores and initial cognitive abilities as measured by the electro-mechanical achievement test. At the end of the school year the differences which indicated gains on the basis of achievement test scores were insignificant. Stated in another manner, the subjects of the traditional program achieved scores which were comparable to the scores achieved by the students of the cluster concept. The experimental group made a gain of 9.2 on the mean between the pretest and posttest. The control group only scored a mean gain of .714 points. The inference was made that the variables described in Part III had serious effects on the program and indirectly pointed to the elements of the program that must be refined and revised in order to improve the effectiveness of the program.

School M. At the completion of the experiment thirteen students formed the experimental group. However, complete data were available for ten of these students. As a result, data from ten cluster subjects were used in the statistical treatment. Ten students were randomly drawn from another class to form the control group. The control group consisted of students enrolled in a vocational air conditioning and refrigeration class, taught by another instructor. The decision to use these students for a control group was based on the similarity of the learning experiences they had to those structured in the electro-mechanical cluster. These students had previously been enrolled in courses dealing with electricity, air conditioning and refrigeration.

Comparability of groups. Comparability of the experimental and control groups for School M was established on the basis of similarity of curriculum and scores from the mechanical reasoning test scores.

The mean mechanical reasoning scores for the experimental and control groups were 38.300 and 38.450, respectively. A test for significance of the differences among mechanical reasoning scores between the two groups yielded a Mann-Whitney U-Test z value of 1.889. See Table 28. This value was less than the value of z required for rejection of the null hypothesis. Accordingly, the judgement was made to accept the differences between the groups as insignificant. Thus, the groups were identified as comparable on the scores derived from the mechanical reasoning test.

Initial differences on achievement. The electro-mechanical achievement test was administered to both the experimental and control groups of School M to determine the estimated level of student knowledge at the beginning of the experiment. Mean scores for the two groups were 46 and 49, respectively. The derived data were treated with the Mann-Whitney U-Test for purposes of statistically determining if significant differences existed between the initial achievement of the two groups. See Table 28. The z value observed in this comparison of test scores was .065. This low z value resulted in the retention of the null hypothesis that there were no significant differences between the scores of the two groups on the basis of achievement test scores. Accordingly, both classes were similar on the variables measured by the electro-mechanical cognitive abilities test.

Final differences on achievement. The derived means from the post-test for the experimental and control groups were 50.000 and 51.300, respectively. See Table 7. The Mann-Whitney U-Test was employed to test the research hypothesis that there were significant differences between the data derived from both groups on the posttest of achievement. A z of 1.625 was obtained. See Table 28. Since a z value of 1.96 was necessary to reject at the .05 level of significance, the null hypothesis was retained. Stated in another manner, statistically significant differences were not found between the scores of the two treatment groups.

Gains on achievement. Data were gathered to obtain an estimate if any growth had taken place in the interim between the pretest and posttest. A pretest mean of 45.000 and a posttest mean of 50.000 was observed for the experimental group. See Table 7. The Mann-Whitney U-Test yielded a z of 1.247 which led to the retention of the null hypothesis that there were no significant differences in the gains in achievement from pretest to posttest.

The control groups means for the pretest and posttest were 49.000 and 51.300, respectively. A Mann-Whitney U-Test z value of 1.744 was obtained. Since this value was less than the z value necessary for rejection, the null hypothesis was retained. See Table 29.

Summary statement on achievement for School M. The subjects of School M were observed to be comparable on mechanical reasoning scores and also the initial cognitive abilities achievement test. At the end of the school year data indicated a mean gain of 5.00 for the experimental group and 2.30 for the control group. These differences derived from achievement test scores were observed to be statistically insignificant. The inference was made that the variables described in Part III had serious effects on the program and indirectly point to the elements of the program that must be further refined and revised in order to improve the effectiveness of the program.

School K. The pilot program for the electro-mechanical cluster at School K was dissolved due to a number of unexpected problems. At the outset of the school year subjects of the cluster program were combined with non-cluster students studying electricity. This hetrogeneity was a burden to the teacher and posed difficulties for implementing and evaluating the program. The situation was further confounded with undesirable variables and by class schedules which were based on a module plan. Under this plan students changed classes at blocks of fifteen minute intervals of time. The requirements of the cluster program or vocational education programs required a student to attend a class two periods a day and five days a week for a full academic year. At School K the entire school changed classes in December or approximately after twelve weeks of school. After this change the cluster students were dispersed into different classes and meeting at variously spaced intervals of time. The homogeneity of the cluster class was impaired. Efforts to correct the condition were made by appealing to the principal. His unchangeable position to keep the students scheduled as they were presented an insurmountable obstacle. Accordingly, the decision was made to drop this school from the study since it did not meet the expectations and specifications for a cluster program.

TABLE 4

HOMOGENEITY OF VARIANCE BETWEEN GROUPS WITHIN EACH SCHOOL
(Based on I.Q. Scores)

School or Group	N	S.D.	Variance	F max[1]
Ac*	15	11.438	130.827	
Ae*	15	7.968	63.489	2.06
Bc	16	10.052	101.043	
Be	16	14.500	210.250	2.08
Cc	14	14.432	208.283	
Ce	14	14.532	211.179	1.01
Ec	16	11.975	143.400	
Ee	16	12.084	146.023	1.02
Hc	15	11.439	130.850	
He	15	15.102	228.070	1.74
Jc	15	11.975	143.400	
Je	15	10.845	117.614	1.22

K = 2, n = 13, the critical region is F max 3.14 at the .05 level
K = 2, n = 15, the critical region is F max 2.86 at the .05 level
K = 2, n = 16, the critical region is F max 2.78 at the .05 level

*c for control group; e for experimental group

---

[1] H. O. Hartley, "The Maximum F Ratio as a Short Cut Test for Heterogeneity of Variance," *Biometrika,* 37 (December, 1950), 308-312.

TABLE 5

MEANS AND STANDARD DEVIATIONS DERIVED FROM INTELLIGENCE TESTS

School	N	Experimental Group X	Experimental Group s	N	Control Group X	Control Group s
A	15	99.267	7.968	15	93.867	11.438
B	16	95.438	14.500	16	101.375	10.052
C	12	89.500	14.532	12	91.584	14.432
D**	13	-1.05*	.32	13	-.89*	.26
E	16	104.200	12.084	16	100.400	11.975
D***	15	-.84*	.05	15	-.58*	.22
G	7	96.714	13.685	7	No Data Available	
H	15	87.934	15.102	15	93.867	11.439
J	15	100.200	10.845	15	100.400	11.975
K		(no data, dropped from research)				

*Average on basis of "z" scores obtained from verbal abilities of Lorge-Thorndike Test.

**Construction Cluster, Teacher D

***Metal Forming and Fabrication Cluster, Teacher F

TABLE 6

HOMOGENEITY OF VARIANCE BETWEEN GROUPS WITHIN EACH SCHOOL
(Based on Pretest of Achievement)

School or Group	N	S.D.	Variance	F max[1]
Ac*	15	8.738	76.353	
Ae*	15	5.356	28.687	2.661
Bc	16	10.049	100.982	
Be	16	9.029	81.523	1.238
Cc	14	5.169	26.761	
Ce	14	5.543	37.250	1.391
Dc**	13	5.994	35.928	
De	13	9.367	87.741	2.442
Ec	16	15.011	225.330	
Ee	16	9.029	81.522	2.764
Dc***	15	12.760	162.818	
De	15	7.841	61.481	2.648
Hc	15	6.104	37.259	
He	15	5.232	27.374	1.361
Jc	15	8.733	76.265	
Je	15	11.249	126.540	1.659

K = 2, n = 13, the critical region is F max 3.14 at the .05 level
K = 2, n = 15, the critical region is F max 2.86 at the .05 level
K = 2, n = 16, the critical region is F max 2.78 at the .05 level

*c for control group; e for experimental group
**Construction Cluster, Teacher D
***Metal Forming and Fabrication Cluster, Teacher F

---

[1] H. O Hartley, "The Maximum F Ratio as a Short Cut Test for Heterogeneity of Variance," Biometrika, 37 (December, 1950), 308-312.

TABLE 7

MEANS AND STANDARD DEVIATIONS DERIVED FROM CLUSTER PROGRAM ACHIEVEMENT TESTS

School	Experimental Group					Control Group				
		Pretest		Posttest			Pretest		Posttest	
	N	X	s	X	s	N	X	s	X	s
A - Construction	15	29.067	8.738	44.467	15.743	15	21.467	5.357	21.933	4.199
B - Metals	16	44.250	10.049	50.312	13.583	16	39.062	9.029	37.062	9.567
C - Construction	14	21.571	5.170	28.929	9.161	14	20.563	5.543	21.929	4.358
D - Construction	13	23.538	5.995	32.079	14.332	13	25.077	9.367	23.538	5.896
E - Metals	16	37.500	15.001	45.625	10.645	16	29.062	9.029	37.062	9.567
D*- Metals	15	40.533	12.761	49.867	8.331	15	35.267	7.842	38.333	9.499
G - Electro-Mech	7	41.143	11.466	50.428	13.1131	7	54.143	6.817	54.857	9.494
H - Construction	15	23.533	6.105	24.867	5.502	15	21.667	5.233	21.933	4.199
M - Electro-Mech	10	46.000	13.767	50.000	13.912	10	49.000	10.011	51.300	10.176
J - Metals	15	49.867	8.733	57.000	9.710	15	40.600	11.249	44.066	10.957

*Teacher F

TABLE 8

ANALYSIS OF VARIANCE OF CONSTRUCTION ACHIEVEMENT
TEST SCORES, EXPERIMENTAL VS. CONTROL GROUP
ON PRETEST AND POSTTEST MEASURES

	Sum of Squares	df	Mean Square	F Ratio
School A Pretest				
Between Groups	433.200	1	433.200	8.248**
Within Groups	1470.667	28	52.524	
TOTAL	1903.867	29		
School A Posttest				
Between Groups	3808.133	1	3808.133	28.689**
Within Groups	3716.667	28	132.738	
TOTAL	7524.700	29		
School C Pretest				
Between Groups	876.042	1	876.042	3.802
Within Groups	5068.583	22	230.390	
TOTAL	5944.625	23		
School C Posttest				
Between Groups	852.042	1	852.042	8.099**
Within Groups	2314.583	22	105.208	
TOTAL	3166,625	23		

**Significant at the .01 level

TABLE 9

ANALYSIS OF VARIANCE OF INTELLIGENCE TEST SCORES BETWEEN THE EXPERIMENTAL AND CONTROL GROUPS OF THE CONSTRUCTION CLUSTER PROGRAM

	Sum of Squares	df	Mean Square	F Ratio
School H				
Between Groups	264.033	1	264.033	1.471
Within Groups	5024.666	28	179.452	
TOTAL	5288.699	29		
School C				
Between Groups	26.042	1	26.042	.124
Within Groups	4613.917	22	209.724	
TOTAL	4639.958	23		
School A				
Between Groups	218.700	1	218.700	2.251
Within Groups	2720.667	28	97.167	
TOTAL	2939.367	29		

TABLE 10

ANALYSIS OF VARIANCE FOR DIFFERENCES BETWEEN PRE AND POSTTEST MEASURES OF ACHIEVEMENT (Based on Construction Cluster Tests)

	Sum of Squares	df	Mean Square	F Ratio
School A, Experimental Group				
Between Groups	1778.700	1	1778.700	10.974**
Within Groups	4538.667	28	162.667	
TOTAL	6317.367	29		
School A, Control Group				
Between Groups	1.633	1	1.633	0.071
Within Groups	648.667	28	23.167	
TOTAL	650.300	29		
School D, Experimental Group				
Between Groups	1059.106	1	1059.106	5.05*
Within Groups	4613.917	22	209.724	
TOTAL	5673.023	23		
School D, Control Group				
Between Groups	234.848	1	234.848	2.01
Within Groups	2570.460	22	116.840	
TOTAL	2805.308	23		

**Significant at the .01 level
*Significant at the .05 level

TABLE 11

ANALYSIS OF VARIANCE FOR DIFFERENCES BETWEEN PRE AND POSTTEST MEASURES OF ACHIEVEMENT
(Based on Construction Cluster Tests)

	Sum of Square	df	Mean Square	F Ratio
School H, Experimental Group				
Between Groups	168.835	1	168.835	5.01*
Within Groups	945.467	28	33.767	
TOTAL	1114.302	29		
School H, Control Group				
Between Groups	1.633	1	1.633	0.071
Within Groups	648.667	28		
TOTAL	650.300	29		
School C, Experimental Group				
Between Groups	381.654	1	381.654	6.121*
Within Groups	1371.583	22	62.345	
TOTAL	1753.237	23		
School C, Control Group				
Between Groups	2.667	1	2.667	0.047
Within Groups	1247.166	22	56.689	
TOTAL	1249.833	23		

*Significant at the .05 level

TABLE 12

ANALYSIS OF VARIANCE OF CONSTRUCTION ACHIEVEMENT TEST SCORES, EXPERIMENTAL VS. CONTROL GROUP ON PRETEST AND POSTTEST MEASURES

	Sum of Squares	df	Mean Square	F Ratio
School H Pretest				
Between Groups	26.133	1	26.133	0.809
Within Groups	905.067	28	32.324	
TOTAL	931.200	29		
School H Posttest				
Between Groups	64.533	1	64.533	2.694
Within Groups	670.667	28	23.952	
TOTAL	735.200	29		
School D Pretest				
Between Groups	15.385	1	15.385	0.249
Within Groups	1484.154	24	61.840	
TOTAL	1499.539	25		
School D Posttest				
Between Groups	499.885	1	499.885	4.407*
Within Groups	2722.154	24	113.417	
TOTAL	3222.039	25		

*Significant at the .05 level

TABLE 13

ANALYSIS OF VARIANCE OF METAL FORMING AND FABRICATION ACHIEVEMENT TEST SCORES, EXPERIMENTAL GROUP VS. CONTROL GROUP ON PRETEST AND POSTTEST MEASURES

	Sum of Squares	df	Mean Square	F Ratio
School B Pretest				
Between Groups	215.281	1	215.281	2.359
Within Groups	2737.938	30	91.265	
TOTAL	2953.219	31		
School B Posttest				
Between Groups	584.500	1	584.500	4.236*
Within Groups	4140.375	30	138.013	
TOTAL	4724.875	31		
School J Pretest				
Between Groups	644.033	1	644.033	6.351*
Within Groups	2839.333	28	101.405	
TOTAL	3483.367	29		
School J Posttest				
Between Groups	1254.533	1	1254.533	11.705**
Within Groups	3000.933	28	107.176	
TOTAL	4255.467	29		

*Significant at the .05 level
**Significant at the .01 level

TABLE 14

ANALYSIS OF VARIANCE FOR DIFFERENCES BETWEEN
PRE AND POSTTESTS MEASURES OF ACHIEVEMENT
(Based on Metal Forming and Fabrication Test)

	Sum of Squares	df	Mean Square	F Ratio
School B, Experimental Group				
Between Groups	1014.938	1	1014.938	7.110**
Within Groups	4282.437	30	142.748	
TOTAL	5297.375	31		
School B, Control Group				
Between Groups	32.000	1	32.000	.370
Within Groups	2595.875	30	86.530	
TOTAL	2627.875	31		
School D* Experimental Group				
Between Groups	653.333	1	653.333	5.626**
Within Groups	3257.467	28	116.124	
TOTAL	3904.800	29		
School D* Control Group				
Between Groups	70.533	1	70.533	0.930
Within Groups	2124.267	28	75.867	
TOTAL	2194.800	29		

*Metal Forming and Fabrication Cluster, Teacher F

**Significant at the .05 level

TABLE 15

ANALYSIS OF VARIANCE OF INTELLIGENCE TEST SCORES BETWEEN THE EXPERIMENTAL AND CONTROL GROUPS OF THE METAL FORMING AND FABRICATION CLUSTER PROGRAM

	Sum of Squares	df	Mean Square	F Ratio
School J				
Between Groups	0.300	1	0.300	.003
Within Groups	3654.000	28	130.500	
TOTAL	3654.300	29		
School E				
Between Groups	108.300	1	180.300	.748
Within Groups	4052.000	28	144.714	
TOTAL	4160.300	29		
School B				
Between Groups	282.031	1	282.031	1.812
Within Groups	4669.688	30	155.656	
TOTAL	4951,719	31		
School D*				
Between Groups	3.02	1	3.02	.480
Within Groups	173.00	28	6.17	
TOTAL	176.02	29		

*Metal Forming and Fabrication Cluster, Teacher F

TABLE 16

ANALYSIS OF VARIANCE OF METAL FORMING AND FABRICATION ACHIEVEMENT TEST SCORES, EXPERIMENTAL GROUP VS. CONTROL GROUP ON PRETEST AND POSTTEST MEASURES

	Sum of Squares	df	Mean Square	F Ratio
School D* Pretest				
Between Groups	208.033	1	208.033	1.855
Within Groups	3140.667	28	112.167	
TOTAL	3348.700	29		
School D* Posttest				
Between Groups	997.633	1	997.633	12.498**
Within Groups	2235.067	28	79.824	
TOTAL	3232.70	29		
School E Pretest				
Between Groups	19.531	1	19.531	0.127
Within Groups	4602.938	30	153.431	
TOTAL	4622.469	31		
School E Posttest				
Between Groups	586.531	1	586.531	5.727**
Within Groups	3072.688	30	102.423	
TOTAL	3659.219	31		

*Metal Forming and Fabrication Cluster, Teacher F

**Significant at the .05 level

TABLE 17

ANALYSIS OF VARIANCE FOR DIFFERENCES BETWEEN PRE AND POSTTEST MEASURES OF ACHIEVEMENT (Based on Metal Forming and Fabrication Test)

	Sum of Squares	df	Mean Square	F Ratio
School J, Experimental Group				
Between Groups	381.633	1	381.633	4.480*
Within Groups	2387.733	28	85.2762	
TOTAL	2769.366	29		
School J, Control Group				
Between Groups	90.133	1	90.133	0.731
Within Groups	3452.533	28	123.304	
TOTAL	3542.666	29		
School E, Experimental Group				
Between Groups	1032.533	1	1032.533	6.240*
Within Groups	4633.333	28	165.476	
TOTAL	5665.866	29		
School E, Control Group				
Between Groups	90.133	1	90.133	0.731
Within Groups	3452.533	28	123.305	
TOTAL	3542.666	29		

*Significant at the .05 level

Mechanical reasoning abilities. The cognitive aspect of this study was limited to those related to knowledges of vocational education presented in the previous pages and a study of the knowledges of applied sciences as measured by the Mechanical Reasoning Test,[3] a distinct and separate part of the D.A.T. It was administered to all groups as a pre and posttest instrument. The purpose of using this test was twofold. In the event the verbal or lingual or intelligence test score were incomplete or unavailable for a satisfactory number of students, comparability would be established on this test as a criteria. Data from this instrument also provided an index for establishing an estimate of the effect of the cluster programs on the development of knowledge from the field of applied sciences. Accordingly, the problems investigated were: What were the differences, on the test scores, if any, between the experimental and control groups at the beginning and the end of the experiment? Were there any significant differences between the experimental and control groups on data derived from posttest scores? Did the cluster concept programs contribute to or facilitate growth on these variables to a greater extent than the traditional program? What implications do these findings have for the cluster concept programs?

Findings and discussion. A visual inspection of Table 18 provides the reader with the data indicating that, within the twenty groups of students of various sizes, the mean scores (for pretest vs. posttest) ranged from a minimal change of -.7 points to a maximum of 8.334 points. The minimal change was recorded for School E, control group, whereas, the maximal was recorded for School C, experimental group. Prior to testing the data with the analysis of variance the test for the homogeneity of variance was executed. See Table 19. It was established that homogeneity of variance existed on the basis of data derived. The various F ratios observed are presented in Tables 20, 21, 22, and 23. None of the values obtained were significant, indicating that there were no significant differences between the control groups and the experimental groups when compared on the initial test and also the final test. This was taken to indicate that both types of vocational education programs make a negligent contribution to the development of the abilities required to solve the problems of applied science as measured by the Mechanical Reasoning Test.

---

[3] George K. Bennett, Harold G. Seashore, Alexander G. Wesman, "Differential Aptitude Test, Mechanical Reasoning (Form A)," Psychological Corporation, New York, 1947.

The problem was investigated further by obtaining an estimate of the gains each cluster and each control group made on the mechanical reasoning test scores.

The analysis of variance was used to test the hypothesis of no significant difference between pretest and posttest scores for each group. Tables 24, 25, 26, and 27 present the various F ratio values observed. None of the groups achieved scores high enough to reject the null hypothesis. Accordingly, the data were taken to indicate that both the traditional programs of vocational education and the cluster concept program contribute insignificant amounts of knowledge to the variables measured by the mechanical reasoning test. Due to the limitations of the subjects to solve problems of a formal hypothetical nature, the inference was drawn that emphasis in these programs were on concrete cognitive functioning. Some teachers, due to preferences and other reasons, tend to make the practical manipulative aspects as dominant over other aspects of a program, or they may hold to a belief that other courses of study will develop the theoretical knowledge of the applied sciences. It is recommended that the cluster concept educators develop a better balance and sequence between manipulative and theoretical aspects of the program.

Since the data indicated that this aspect of both vocational programs are wanting, it was not suggested that both schemes be discarded but that much can and should be done to improve the programs. Deliberate emphasis of the scientific aspects underlying the tasks of the occupations was recommended not only for the vocational teacher but also for the mathematics and science teachers.

Affective Behaviors

The point of view taken in this study was that no single source of information would provide an adequate basis for making comprehensive decisions about the effectiveness of and suggestions for improving the cluster program. Since the program is vocational in nature, it was decided that occupational interests of the subjects must be investigated.

To investigate the occupational interests and what changes of interests occur, if any, the Minnesota Vocational Interest Inventory[4] was administered at the beginning and at the end of the school year to all subjects included in this study. After a study of the various available instruments, it was decided that the MVII was most applicable

---

[4] David P. Campbell, Ibid.

TABLE 18

MEANS AND STANDARD DEVIATIONS DERIVED FROM THE MECHANICAL REASONING ABILITIES TEST (D.A.T.)

School	Experimental Group					Control Group				
		Pretest		Posttest			Pretest		Posttest	
	N	X	s	X	s	N	X	s	X	s
A - Construction	15	40.300	10.099	43.000	12.691	15	36.900	14.142	41.667	15.139
B - Metals	16	30.219	13.848	32.350	13.953	16	32.937	12.044	32.250	14.929
C - Construction	12	38.833	9.074	47.167	13.855	12	26.917	11.317	35.083	16.395
D - Construction	13	29.692	11.058	37.231	11.708	13	31.962	9.67	34.154	10.329
E - Metals	16	34.875	11.103	39.688	10.389	16	32.938	12.044	32.218	14.929
D*- Metals	15	32.500	13.023	36.900	9.343	15	32.600	10.477	35.467	11.086
G - Electro-Mech	7	29.000	16.086	35.912	15.001	7	39.214	18.563	Not Available	
H - Construction	15	30.267	13.014	34.807	17.411	15	36.900	14.142	41.667	15.139
M - Electro-Mech	10	38.300	10.889	42.800	9.411	10	38.450	17.802	43.842	10.811
J - Metals	15	35.323	12.958	38.967	11.283	15	34.303	11.767	38.933	11.439

*Teacher F

TABLE 19

HOMOGENEITY OF VARIANCE BETWEEN GROUPS WITHIN EACH SCHOOL
(Based on Pretest Mechanical Reasoning)

School or Group	N	S.D.	Variance	F max[1]
Ac*	15	10.099	101.999	
Ae*	15	14.142	199.996	1.961
Bc	16	16.138	260.435	
Be	16	12.044	145.058	1.795
Cc	12	11.317	128.075	
Ce	12	9.074	82.338	1.55
Dc**	13	11.057	122.257	
De	13	10.328	106.668	1.146
Ec	16	11.103	123.277	
Ee	16	12.044	145.058	1.176
Dc***	15	13.023	143.553	
De	15	10.447	109.140	1.315
Hc	15	13.013	169.338	
He	15	14.142	199.996	1.181
Jc	15	12.958	167.910	
Je	15	11.766	138.439	1.207

K = 2, n = 13, the critical region is F max 3.14 at the .05 level
K = 2, n = 15, the critical region is F max 2.86 at the .05 level
K = 2, n = 16, the critical region is F max 2.78 at the .05 level

*c for control group; e for experimental group
**Construction Cluster, Teacher D
***Metal Forming and Fabrication Cluster, Teacher F

---

[1] H. O. Hartley, "The Maximum F Ratio as a Short Cut Test for Heterogeneity of Variance," Biometrika, 37 (December, 1950), 308-312.

TABLE 20

ANALYSIS OF VARIANCE OF DATA FROM MECHANICAL REASONING ABILITIES TEST (D.A.T.) EXPERIMENTAL GROUPS VS. CONTROL GROUP ON PRE AND POSTTEST MEASURES

	Sum of Squares	df	Mean Square	F Ratio
School A Pretest				
Between Groups	86.700	1	86.700	0.574
Within Groups	4228.000	28	157.000	
TOTAL	4314.700	29		
School A Posttest				
Between Groups	13.333	1	13.333	0.068
Within Groups	5463.833	28	195.137	
TOTAL	5477.166	29		
School H Pretest				
Between Groups	330.008	1	330.008	1.787
Within Groups	5171.033	28	184.680	
TOTAL	5501.041	29		
School H Posttest				
Between Groups	352.947	1	352.947	1.326
Within Groups	7452.982	28		
TOTAL	7805.929	29		

*Significant at the .05 level

TABLE 21

ANALYSIS OF VARIANCE OF DATA FROM MECHANICAL REASONING ABILITIES TEST (D.A.T.) EXPERIMENTAL VS. CONTROL GROUP ON PRE AND POSTTEST MEASURES

	Sum of Squares	df	Mean Square	F Ratio
School B Pretest				
Between Groups	59.133	1	59.133	0.351
Within Groups	5052.422	30	168.414	
TOTAL	5111.555	31		
School B Posttest				
Between Groups	0.008	1	0.008	0.000
Within Groups	6263.484	30	208.783	
TOTAL	6263.492	31		
School J Pretest				
Between Groups	7.500	1	7.500	0.049
Within Groups	4289.166	28	153.184	
TOTAL	4296.666	29		
School J Posttest				
Between Groups	0.008	1	0.008	0.000
Within Groups	3614.166	28	129.077	
TOTAL	3614.174	29		

*Significant at the .05 level

TABLE 22

ANALYSIS OF VARIANCE OF DATA FROM MECHANICAL REASONING ABILITIES TEST (D.A.T.) EXPERIMENTAL VS. CONTROL GROUP ON PRE AND POSTTEST MEASURES

	Sum of Squares	df	Mean Square	F Ratio
School C Pretest				
Between Groups	222.893	1	222.893	1.149
Within Groups	5044.464	26	194.018	
TOTAL	5267.357	27		
School C Posttest				
Between Groups	195.571	1	195.571	1.074
Within Groups	4734.393	26	182.092	
TOTAL	4929.964	27		
School D Pretest				
Between Groups	129.385	1	129.385	1.130
Within Groups	2747.461	24	114.478	
TOTAL	2876.846	25		
School D Posttest				
Between Groups	180.471	1	180.471	
Within Groups	2789.538	24	116.231	
TOTAL	2970.009	25		

*Significant at the .05 level

TABLE 23

ANALYSIS OF VARIANCE OF DATA FROM MECHANICAL REASONING ABILITIES TEST (D.A.T.) EXPERIMENTAL VS. CONTROL GROUP ON PRE AND POSTTEST MEASURES

	Sum of Squares	df	Mean Square	F Ratio
School E Pretest				
Between Groups	30.031	1	30.031	0.224
Within Groups	4025.187	30	134.173	
TOTAL	4055.218	31		
School E Posttest				
Between Groups	446.258	1	446.258	2.698
Within Groups	4961.922	30	165.397	
TOTAL	5408.180	31		
School D** Pretest				
Between Groups	0.075	1	0.075	.000
Within Groups	3902.600	28	139.379	
TOTAL	3902.675	29		
School D** Posttest				
Between Groups	15.408	1	15.408	.015
Within Groups	2942.833	28	105.101	
TOTAL	2958.241	29		

*Significant at the .05 level

**Metal Forming and Fabrication Cluster, Teacher F

TABLE 24

ANALYSIS OF VARIANCE OF DATA FROM MECHANICAL REASONING ABILITIES TEST (D.A.T.) PRETEST VS. POSTTEST

	Sum of Squares	df	Mean Square	F Ratio
School A Experimental				
Between Groups	1248.075	1	1248.075	0.727
Within Groups	48096.098	28	1717.717	
TOTAL	49344.173	29		
School A Control				
Between Groups	170.408	1	170.408	0.794
Within Groups	6008.933	28	214.605	
TOTAL	6179.341	29		
School D Experimental				
Between Groups	1.633	1	1.633	.071
Within Groups	648.667	28	23.167	
TOTAL	650.300	29		
School D Control				
Between Groups	90.133	1	90.133	.731
Within Groups	3452.533	28	123.304	
TOTAL	3542.666	29		

*Significant at the .05 level

TABLE 25

ANALYSIS OF VARIANCE OF DATA FROM MECHANICAL REASONING ABILITIES TEST (D.A.T.) PRETEST VS. POSTTEST

	Sum of Squares	df	Mean Square	F Ratio
School B Experimental				
Between Groups	33.008	1	33.008	.171
Within Groups	5796.984	30	194.238	
TOTAL	5829.992	31		
School B Control				
Between Groups	4.133	1	4.133	.023
Within Groups	5518.922	30	183.964	
TOTAL	5523.055	31		
School D** Experimental				
Between Groups	145.200	1	145.200	1.130
Within Groups	3596.600	28	128.450	
TOTAL	3741.800	29		
School D** Control				
Between Groups	61.633	1	61.633	.053
Within Groups	3248.833	28	116.030	
TOTAL	3310.466	29		

*Significant at the .05 level

**Metal Forming and Fabrication Cluster, Teacher F

TABLE 26

ANALYSIS OF VARIANCE OF DATA FROM MECHANICAL REASONING ABILITIES TEST (D.A.T.) PRETEST VS. POSTTEST

	Sum of Squares	df	Mean Square	F Ratio
School H Experimental				
Between Groups	258.720	1	258.720	1.277
Within Groups	5676.149	28	202.720	
TOTAL	5934.870	29		
School H Control				
Between Groups	99.008	1	99.008	0.671
Within Groups	4133.067	28	147.610	
TOTAL	4232.075	29		
School C Experimental				
Between Groups	181.500	1	181.500	1.553
Within Groups	2520.458	22	116.839	
TOTAL	2751.958	23		
School C Control				
Between Groups	60.167	1	60.167	0.460
Within Groups	2874.291	22	130.650	
TOTAL	2934.458	23		

*Significant at the .05 level

TABLE 27

ANALYSIS OF VARIANCE OF DATA FROM MECHANICAL REASONING ABILITIES TEST (D.A.T.) PRETEST VS. POSTTEST

	Sum of Squares	df	Mean Square	F Ratio
School J Experimental				
Between Groups	99.008	1	99.008	0.671
Within Groups	4133.067	28	147.610	
TOTAL	4232.075	29		
School J Control				
Between Groups	158.700	1	158.700	1.179
Within Groups	3770.266	28	134.652	
TOTAL	3928.966	29		
School E Experimental				
Between Groups	60.208	1	60.208	.4252
Within Groups	3964.967	28	141.606	
TOTAL	4025.175	29		
School E Control				
Between Groups	158.700	1	158.700	1.179
Within Groups	3770.267	28	134.652	
TOTAL	3928.967	29		

*Significant at the .05 level

TABLE 28

MANN-WHITNEY U TEST SUMMARY TABLES

MANN-WHITNEY U TEST SUMMARY TABLE EXPERIMENTAL GROUP VS. CONTROL GROUP ON PRETEST ACHIEVEMENT

School G . . . . z = 1.023
School M . . . . z = .065

MANN-WHITNEY U TEST SUMMARY TABLE EXPERIMENTAL GROUP VS. CONTROL GROUP ON POSTTEST ACHIEVEMENT

School G . . . . z = .064
School M . . . . z = 1.625

MANN-WHITNEY U TEST SUMMARY TABLE EXPERIMENTAL GROUP VS. CONTROL GROUP ON PRETEST MECHANICAL REASONING

School G . . . . z = 1.214
School M . . . . z = 1.889

MANN-WHITNEY U TEST SUMMARY TABLE EXPERIMENTAL GROUP VS. CONTROL GROUP ON POSTTEST MECHANICAL REASONING

School G . . . . z = .831
School M . . . . z = .767

---

[*] The rejection region for significance at the .05 level is 1.96.

TABLE 29

MANN-WHITNEY U TEST SUMMARY TABLES

MANN-WHITNEY U TEST SUMMARY TABLE FOR THE INCREASE IN MECHANICAL REASONING ABILITY WITHIN THE ELECTRO-MECHANICAL CLUSTER

School G	Experimental Group	$z = .831$
School G	Control Group	$z = .064$
School M	Experimental Group	$z = 1.889$
School M	Control Group	$z = .409$

MANN-WHITNEY U TEST SUMMARY TABLE FOR THE GROWTH IN ACHIEVEMENT WITHIN THE ELECTRO-MECHANICAL CLUSTER

School G	Experimental Group	$z = 1.340$
School G	Control Group	$z = 1.023$
School M	Experimental Group	$z = 1.247$
School M	Control Group	$z = 1.744$

[*] Rejection region $z = 1.96$

TABLE 30

SUMMARY TABLE OF OMEGA SQUARES[1] FOR ESTIMATES OF TREATMENT EFFECTS BETWEEN POSTTESTS OBTAINED FROM EXPERIMENTAL VS. CONTROL GROUPS

School	Omega Square
A	.48
B	.09
C	.23
D	.12
E	.13
D*	.28
J	.36

Note: School H did not yield a significant F statistic. (Omega square was not applicable)

Schools G and M employed the Mann-Whitney U-Test. (Omega square was not applicable)

*Metal Forming and Fabrication Cluster, Teacher F to this study because it evaluated interests of semi-skilled and skilled occupations.

---

[1] William L. Hays, Statistics for Psychologists, New York: Holt, Rinehart and Winston, 1963, pp. 325-326.

The subjects included in this research ranged in ages from fifteen to nineteen. According to the suggestions of the author of the MVII, all results derived should be viewed with judgement and some reservation since it was found that student interests change to some extent at this age and do not stabilize in many cases until the age of twenty-five. However, the author also stated that a greater degree of stability was found among individuals of the skilled and semi-skilled occupations than in individuals of the professions. From the data gathered it became evident that students of this study did change their attitudes towards occupations. See Table 31. There were no overall clear patterns or directions of changes in interests. In some, the change was clearly in the direction of the courses in which they were enrolled, whereas, in others, the inverse was observed. The subjects of School A, a construction cluster, generated a total sum change score of 8.4 points in the direction of those occupations related to the cluster concept; whereas, the derived overall change score made by School H, also of the construction cluster, was 16.7 points in a negative direction from the cluster program. See Table 31. A more deliberate study investigating this problem should be conducted. For the purposes of this study, the data suggest that more attention should be given to the guidance and occupational information aspects of the cluster program.

Data derived from students of the traditional vocational education program provided evidence to indicate that the changes that have taken place were similar. This can be observed by studying the data derived from the control groups of School M and D. See Table 32.

These programs required a decision on the part of the students to study a specific occupation. The data gathered indicated that these students were characterized as being ambivalent in their occupational preferences. The expectation of requiring a student to make a commitment to an occupation at this stage of his development is questionable.

The fluctuation of student interests are represented in Table 32. The differences in quantitative values could be attributed to chance and/or error of the instrument. However, the data do indicate that student interests did change within an interval of time of one academic year. Findings such as this lend support to the concept of clustering occupations into which students can achieve entry level skills over a shorter period of time other than in-depth programs of long intervals of time. The cluster programs encourage flexibility by providing more degrees of freedom for the natural changes of interests of youth, whereas, the traditional program requires a student to restrict or confine his interests towards a goal set in the early years of high school.

TABLE 31

RESULTS OF SELECTED EMPERICAL AND HOMOGENEOUS SCALES FROM THE MINNESOTA VOCATIONAL INTEREST INVENTORY

School A Construction Cluster

	Significant Result*	Pre Average Score	Post Average Score	Difference
Carpenter	41+	40.7	40.2	- .5
Painter	39+	35.1	37.5	+2.4
Plasterer	37+	31.1	31.6	+ .5
Plumber	39+	33.7	36.9	+3.2
Electrician	33+	33.1	31.8	-1.3
Mechanical		58.0	56.2	-2.2
Carpentry		44.1	50.4	+6.3

School C Construction Cluster

	Significant Result*	Pre Average Score	Post Average Score	Difference
Carpenter	41+	41.5	32.9	-8.5
Painter	39+	30.1	29.8	-1.3
Plasterer	37+	31.4	36.0	+4.6
Plumber	39+	26.1	24.9	-1.2
Electrician	33+	18.81	16.0	-2.8
Mechanical		47.5	45.3	-2.2
Carpentry		52.8	49.5	-3.3

---

*The student has interests similar to those people working in the occupation if his score is higher than this value.

**A score of 25 or less indicates student has few interests similar to those in the occupation.

Table 31, continued

School D Construction Cluster

	Significant Results*	Pre Average Scores	Post Average Scores	Difference
Carpenter	41+	32.0	31.4	- .6
Painter	39+	30.4	29.5	- .9
Plasterer	37+	32.3	33.3	+1.0
Plumber	39+	28.7	28.8	+ .1
Electrician	33+	19.0	19.6	+ .6
Mechanical		42.1	40.2	-1.9
Carpentry		55.1	31.4	- .6

School H Construction Cluster

	Significant Results*	Pre Average Scores	Post Average Scores	Difference
Carpenter	41+	45.8	38.1	-7.7
Painter	39+	37.5	38.4	+ .9
Plasterer	37+	33.1	32.2	+ .2
Plumber	39+	28.7	25.6	-3.1
Electrician	33+	22.7	18.7	-4.0
Mechanical		47.8	48.6	- .8
Carpentry		55.1	51.7	-3.4

*The student has interests similar to those people working in the occupation if his score is higher than this value.

**A score of 25 or less indicates student has few interests similar to those in the occupation.

Table 31, continued

School G Electro-Mechanical Cluster

	Significant Result*	Pre Average Scores	Post Average Scores	Difference
Electrician	33+	27.8	28.2	+ .4
Radio & TV Repair	33+	31.6	34.2	+2.6
Mechanical		43.6	42.4	+1.2
Electronics		54.8	55.6	+ .8

School M Electro-Mechanical Cluster

	Significant Result*	Pre Average Scores	Post Average Scores	Difference
Electrician	33+	30.2	27.5	-2.7
Radio & TV Repair	33+	37.0	34.5	-2.5
Mechanical		47.2	40.8	-6.4
Electronics		55.0	50.2	-4.8

*The student has interests similar to those people working in the occupation if his score is higher than this value.

**A score of 25 or less indicates student has few interests similar to those in the occupation.

Table 31, continued

School B Metal-Forming & Fabrication Cluster

	Significance Result*	Pre Average Score	Post Average Score	Difference
Sheet Metal Worker	41+	40.0	35.3	-4.7
Machinist	38+	31.9	30.1	-1.8
Mechanical		46.6	44.8	-1.8

School E Metal-Forming & Fabrication Cluster

	Significance Result*	Pre Average Score	Post Average Score	Difference
Sheet Metal Worker	41+	28.8	32.7	+3.9
Machinist	38+	35.5	30.1	-4.2
Mechanical		42.6	40.0	-2.6

*The student has interests similar to those people working in the occupation if his score is higher than this value.

**A score of 25 or less indicates student has few interests similar to those in the occupation.

Table 31, continued

School D Metal-Forming & Fabrication Cluster

	Significant Result*	Pre Average Score	Post Average Score	Difference
Sheet Metal Worker	41+	33.4	27.7	-5.7
Machinist	38+	35.1	32.0	-3.1
Mechanical		45.3	40.7	-4.6

School J Metal-Forming & Fabrication Cluster

	Significant Result*	Pre Average Score	Post Average Score	Difference
Sheet Metal Worker	41+	39.1	39.5	+ .4
Machinist	38+	30.1	30.1	0.0
Mechanical		51.4	46.9	-4.5

*The student has interests similar to those people working in the occupation if his score is higher than this value.

**A score of 25 or less indicates student has few interests similar to those in the occupation.

TABLE 32

RESULTS OF SELECTED EMPERICAL AND HOMOGENEOUS SCALES FROM THE MINNESOTA VOCATIONAL INTEREST INVENTORY

School M Control Group

	Significant Result*	Pre Average Score	Post Average Score	Difference
Carpenter	41+	34.0	32.5	- 1.5
Painter	39+	44.0	32.5	-11.5
Plasterer	37+	33.5	25.0	- 8.5
Sheet Metal Worker	41+	31.2	29.2	- 2.0
Plumber	39+	27.5	16.5	-11.0
Machinist	38+	25.5	32.5	+ 7.0
Electrician	33+	26.5	15.8	+10.7
Radio & TV Repair	33+	28.5	31.0	+ 2.5
Mechanical		50.5	42.7	- 7.8
Electronics		51.0	46.7	- 4.3
Carpentry		50.5	47.7	- 2.8

School F Control Group

	Significant Result*	Pre Average Score	Post Average Score	Difference
Carpenter	41+	26.1	30.0	+ 3.9
Painter	39+	24.0	27.3	+ 3.3
Plasterer	37+	22.7	26.1	+ 3.4
Sheet Metal Worker	41+	26.2	25.8	- .4
Plumber	39+	15.2	21.6	+ 5.4
Machinist	38+	28.0	26.0	- 2.0
Electrician	33+	15.2	20.0	+ 5.3
Radio & TV Repair	33+	28.1	27.6	- .5
Mechanical		41.8	41.0	- .8
Electronics		46.1	49.8	+ 3.2
Carpentry		46.6	47.3	- 1.3

*The student has interests similar to those people working in the occupation if his score is higher than this value.

**A score of 25 or less indicates student has few interests similar to those in the occupation.

Occupational Information

The evaluation of the cluster program by means of the effect on the students included a consideration of the students' knowledge of related information and job expectations other than the technical skills and knowledges to do a job. All occupations require the worker to cope with problems of human relations, status, security, advancement, renumeration, change of duties, change of equipment and, sometimes, geographic displacement. In order to obtain an estimate of the students' knowledge and attitude about these factors, a questionnaire was devised and administered as a pre and posttest measure. The questionnaire was designed to elicit the students' opinion concerning factors dealing with preparational mode best suited for job entry, characteristics of occupations throughout the country and occupational choices of the students.

The data derived was summarized into three composite tables, 33, 34 and 35, each of which is based on one of the above categories of students' choice. Data for this table was derived from the Supplementary Questionnaire (Appendix B) in which the students selected, in rank order, the three modes of preparation they felt were important for entry into their selected occupation.

As a preference, the completion of high school was by far the choice of the majority of students. While it was a large percentage, it was also evident that a fair percentage of subjects would not prefer to complete high school. This was taken to indicate that between twenty-five and forty percent of the students are dissatisfied with school, but not that they will drop out of high school.

On-the-job training as a mode of occupational preparation appeared with considerable strength as the second and third most frequent choice.

TABLE 33

COMPOSITE TABLE

PREPARATIONAL MODES IDENTIFIED AS MOST IMPORTANT FOR OCCUPATIONAL ENTRY BY CLUSTER CONCEPT STUDENTS

N = 104

PREPARATIONAL MODES	STUDENT OPINION					
	First Choice		Second Choice		Third Choice	
	pre %	post %	pre %	post %	pre %	post %
COMPLETE HIGH SCHOOL	75	60	8	9	1	6
ON-THE-JOB TRAINING	9	11	28	30	23	21
JOB CORPS	0	0	2	1	4	5
NIGHT SCHOOL	1	0	2	4	6	5
ARMED FORCES	1	4	11	9	9	10
TECHNICAL INSTITUTE	8	7	5	4	12	8
EVENING WORK	0	0	7	7	11	10
APPRENTICESHIP	0	7	23	15	22	13
SUMMER SCHOOL	0	0	0	1	2	3
COMMUNITY COLLEGE	2	4	10	8	6	10
OTHERS:	0	0	0	1	0	1

TABLE 34

STUDENT OCCUPATIONAL CHOICES BY CLUSTER

OCCUPATIONS	First Choice		Second Choice		Third Choice	
	pre	post	pre	post	pre	post
Construction						
N = 47						
Carpenter	18	21	8	10	6	3
Electrician	6	5	3	4	6	10
Mason	8	9	11	6	3	5
Painting	4	4	8	10	9	7
Plumber	2	0	1	2	8	9
Metal Forming & Fabrication						
N = 39						
Assembler	0	0	2	2	4	1
Machinist	13	13	9	2	2	9
Sheet Metal Worker	3	1	3	7	5	4
Welder	11	11	6	5	7	2
Electro-Mechanical						
N = 15						
Air Conditioning	3	2	2	2	4	4
Electrician	3	5	2	1	3	1
Business Machine Serviceman	0	0	1	2	1	1
Home Appliance Serviceman	0	0	2	2	3	2
Radio & TV Serviceman	6	4	2	3	1	1

TABLE 35

STUDENT RESPONSES TO SPECIFIED OCCUPATIONAL CHARACTERISTICS

N = 104

CHARACTERISTICS	YES		NO		NOT SURE	
	pre	post	pre	post	pre	post
1. Jobs preferred available throughout country	92*	89	5*	10	7	5
2. Resident displacement required	27	24	42	44	21	26
3. Vertical advancement within job available	82	77	9	12	13	15
4. Broad background is needed	73	69	16	19	15	16
5. Occupations require growth on job	70	64	6	14	28	26
6. Prefers present area for living	59	46	22	19	23	31
7. Long range salary improvement available	79	80	21	14	4	3
8. Preference of interest over money	14	17	55	59	14	18
9. Expects tool and skill changes	68	69	13	11	23	24
10. Needs broad training rather than for specific job	78	77	14	12	12	15
11. Job skills are more important than human relations	62	61	21	23	18	17
12. Status or prestige associated with job	61	66	8	8	33	28
13. Use job as stepping stone	36	49	29	22	39	33
14. Expects to stay on initial job	72	77	15	14	17	13
15. There is vertical mobility within the field	55	60	19	12	30	32
16. Specialize in one trade for success	29	34	35	29	32	31
17. Choose job whose technology doesn't change	25	24	60	58	15	18

*Numbers of students responding

Twenty-eight percent elected on-the-job training on the pre-measure as a second choice and thirty percent as a second choice on the post-measure. Twenty-three percent of the students selected on-the-job training as a third choice on the pre-measure and twenty-one percent on the post-measure. See Table 33. The slight increase in percentage on the post-measure could possibly be attributed to the orientation of the students to the concepts of entry level skills and that due to the diversity of modern industries, on-the-job training is a necessity.

The apprenticeship program was not selected by any student as a first choice on the pre-measure. It was, however, selected by seven percent of the students on the post-measure as a first choice and by twenty-three percent and fourteen percent on pre and post-measures, respectively, as a third choice. A possible reason advanced for this decrease was that many of the students were from rural areas. By virtue of the occupational information from the teachers, the students realized the lack of local opportunities for apprenticeships and that they were more abundant in large urban areas.

The slight decrease (as determined by the difference between pre and post-measures) in the percentage of students electing the completion of high school as essential for job success can be partially explained by the slight shift of preferences to other modes of occupational preparation. This shift probably resulted from the increase in student awareness that in addition to a high school education, some specialized training is needed to assure occupational success. This awareness was further evidenced by the number of students who considered on-the-job training or attending a technical institute as important factors for future occupational success.

Student occupational choices have been investigated by obtaining data from the same questionnaire. The data is summarized in Table 34 on the basis of pre and post-measures and first, second, and third choice.

The preference for carpentry within the construction cluster is clearly evident. Several reasons are advanced for this observation.

Carpentry tends to have an appeal due to the general familiarity which most people have with it and also because of the "glamour" which is attached to the trade in relation to the four other occupations. In addition, people have more contact with carpenters in day to day life than with other tradesmen and the occupation has a "clean" connotation when compared to many others. At this time, there is a noticeable demand for carpenters, employment opportunities are excellent. All of these factors contribute to generate an appeal for the high school student.

The plumbing occupation, to take a direct opposite, was preferred least by the students and all the positive features of carpentry could be turned around and applied negatively towards plumbing.

Most of the plumber's work is not visible to the casual observer nor does it have the "glamour" attached to carpentry. There is much less chance of having a plumber as an acquaintance and many people attach the stigma of uncleanliness to the work plumbers do.

The results of student occupational choices in the construction cluster do not reveal any real changes in preferences from the pre to the post-measures. All the results appear to indicate is a rather static preference for some occupations in comparison to others. This was taken to suggest that more occupational insight and an appreciation for occupations needs to be developed.

Fewer observations are possible regarding the metal forming and fabrication cluster although choices again appear to have been made on the basis of general knowledge about the occupations. For instance, a noticeable preference was expressed for machinist and welding occupations as opposed to assembly and sheet metal with which high school youths would be less familiar.

The most frequently selected occupations in the electro-mechanical cluster were those about which students were most familiar, such as air conditioning, and radio and television servicing. The occupations of business machine servicemen and appliance repair have not attracted students. It was expected that with larger sample groups more changes would be observed.

Modest changes in preferences were observed within clusters of pre and post-measures. When the first, second, and third choices for each occupation on the pre-measure were summed and compared with the total of first, second, and third choices for each occupation on the post-measure, slightly less change was discernable.

In summary, the data from the questionnaire was found to be perplexing with only a modest reflection of the diverse educational experiences. The unclear pattern and unequal distribution of choices indicate that deliberate effort must be made by the teachers to provide realistic occupational information.

The data and information obtained from the supplementary questionnaire (Appendix B) concerning occupational characteristics were divided into six specific categories. These categories were obtained by grouping related items of the questionnaire, summarized in Table 35 and discussed below.

Geographical Mobility

Items 1, 2, and 6 related to the area of geographic mobility provided data which indicated that students'attitudes remained relatively unchanged. However, there was a noticeable decrease in their preference for employment within the immediate vicinity of their home.

Nature of Work

Item 17 yielded data indicating little change of attitude among students regarding occupational technology. Most students realized on the pre-measure that technological advances would have an effect on the occupation of their choice, and indicated their willingness to accept and keep up with the changing technology.

Vertical Mobility

Items 3, 5, 13, and 15 provided evidence that students tended to realize that experience in an occupation leads to advancement and perhaps new employment and promotions within a company.

Students' attitudes toward vertical mobility within selected occupations revealed that many of the students expected to change jobs rather than remain at one for an extended period of time.

Change of Interest

Items 9 and 14 were related to the students' understanding and anticipation of his own changes of interest relating to occupational choice. Most students realized that technological changes will result in the development of new tools and equipment which they will have to use to perform in their selected occupations. They also realized that their interest in other occupations, plus instruction in these areas would enable them to leave one specialized vocation and seek employment in a related occupation.

Personal Satisfaction

Items 7, 8, and 12 were related to factors dealing with money, interest or status in relation to selected occupations. Most students indicated their interest in well paying jobs on the pre-measure, and the expectations of increased earnings with experience. Most students also selected occupations which were socially acceptable and carried a relative amount of status.

Realistic Preparation

Items 4, 10, 11 and 16 provided data which indicated that most students appreciated the need for entry level training which would enable them to enter different occupations as opposed to specialized training in a specific trade. Students also indicated that the ability to get along with people on the job is more important than knowing every detail of the job.

The responses of the students, while in school, tended to be, in a measure, artificial. It is quite possible that the questions asked were still highly hypothetical and that if they were to enter a job not high in their present preference, that psychological job satisfaction would emerge as their needs for financial independence would be met. Thus, they might realize that their alternate choice of a job can be to some measure satisfying. A follow-up study was planned and it was expected that information on this problem can be obtained.

PART III

EVALUATION OF CLUSTER CONCEPT PILOT PROGRAMS

Introduction

In accordance with the premise that education is the process of changing student behaviors, the report requires at this point, an evaluation of the process of education. The evaluation of the effect of the cluster program on the student has been presented in Part II. For a lack of a rigorous, quantitative methodology to evaluate the dynamic process such as the art of teaching, the methods resorted to were: visitations, gathering of data by observations, and rational interpretation of events. The efforts of evaluation were directed toward the consideration of the administration, the teacher, instruction, physical facilities, equipment and, in a limited way, the community.

Limitations. The following descriptive data, check lists, and written evaluations were generated by the visiting research team. Subjective interpretations and diagnosis of field operations based on scheduled visitations were known to have limitations. Every effort was made to gather information on objective and observed behaviors. No attempt was made to explain causes for teacher or administrative behaviors. The events and situations as they were observed were the targets of the visiting teams.

Field evaluations. Visitations to the participating schools were conducted by two groups at different time intervals. One group was composed of an administrator from the State Department of Vocational

Education, the county supervisor of vocational education, the principal investigator, the research coordinator and the high school principal. This group was considered the supervisory team for the project, whereas the cluster research team (the four research assistants) provided special assistance and guidance for the implementation and evaluation of the new program. The schedule for these visitations were presented in all of the quarterly reports.

The evaluations in the field were conducted with due consideration to the objectives of the cluster concept program and the specific tasks which were stated in behavioral terms. The tasks were built into the course work and evaluation check lists. To perform the evaluation of the educational process, the following activities were completed:

1. Scheduled bi-weekly visitations were conducted with teachers, supervisors, research assistants, project coordinator and principal investigator.
2. Special seminar was conducted for the purpose of enabling the field teachers to share problems associated with implementing the cluster concept program.
3. A special meeting including representatives from the State Department of Education, four country supervisors, eleven principals, and an assistant principal was held early in the school year to plan and to take the steps to assume the introduction of the programs into the school.

Construction Cluster

The construction cluster was designed to develop within the student skills and understandings related to the occupations of carpentry, electricity, masonry, painting, and plumbing. The cluster program was not designed for in-depth development of skills in any one occupation, but aims at preparing students to enter any of the occupations within the construction cluster.

Course Objectives

The following objectives were emphasized in the curriculum for the construction cluster:

1. To broaden the student's understanding of the available opportunities in occupations found in the construction cluster.
2. To develop job entry skills and knowledge for several occupations found in the construction cluster.
3. To develop a favorable attitude toward work in the construction cluster.
4. To develop a student's understanding of the sources of information that will be helpful to him as he moves through the occupational areas.

The specific objectives for the course are the following:

1. To develop the student's competency in the use of common hand tools found in the construction cluster.
2. To develop the student's competency in using power tools and equipment needed for job entry into the occupations found in the construction cluster.

3. To develop the student's understanding of the operations, procedures, and processes associated with the construction cluster.
4. To develop safe working habits related to the occupations within the construction cluster.
5. To familiarize the student with the terminology associated with the construction cluster.
6. To develop an understanding of the resources available to him in his pursuit of the course as well as in his work following graduation.

Description of Construction Cluster Programs

In the following section of the report the pilot program of each school will be discussed with reference to the administration, the teacher, the physical facilities, the instruction, and community involvement.

The information reported was obtained by members of the cluster concept project research team through a series of bi-weekly visitations to the various schools that conducted pilot programs in the construction cluster.

Orientation. School A was located in a rural setting and was composed of grades 7 through 12. The school program consisted of the basic general education courses for grades 7 and 8. Students entering grade 9 selected a program to be followed for the remainder of their high school career. The students selected either the college entrance, business or general curriculum.

The introduction of the construction cluster into this school added another dimension to the practical arts curriculum. In addition to the construction cluster the other practical areas of the curriculum include courses in business, home economics, industrial arts and agricultural education.

The administration. The principal of School A was extremely enthusiastic about the cluster program and was instrumental in helping Teacher A obtain the necessary equipment and materials needed to conduct his program.

Both the principal and the guidance counselor aided Teacher A with problems involving scheduling of students and class time, and with obtaining additional physical facilities in which to conduct certain phases of the program.

The county administration, while favoring the idea of the cluster concept program, provided Teacher A with only minimal support until rather late in the school year. No additional equipment or materials were provided at the start of the school year. Most of the supplies and materials secured during the school year were obtained on emergency requisitions requested by Teacher A or his principal. Textbooks, which were ordered in the Spring of 1967, were not received at any time during the school year and have been reordered for next year. In April of 1968, Teacher A was allotted a sum of money by the supervisor of industrial education which was to be spent by the end of the school year. Requisitions for equipment, supplies, and materials were filled out; most of the requested items had been requisitioned prior to the initiation of the program in September 1967.

The supervisor of industrial education was informed by letter of the scheduled visitations with the cluster concept project teachers in his county, but he did not attend any of the scheduled visitations conducted at School A. However, he did meet with the principal investigator and the project coordinator in December, 1967 and accompanied them on a visitation of the schools. Teacher A had little communication with him during the school year. Most of the communication was generated by Teacher A due to a need for materials, equipment, and textbooks.

The teacher. Teacher A's education consisted of a B.S. and M.A. degrees in Industrial Education. Teacher A had ten years teaching experience at the junior and senior high school level. In addition to three years of experience working for a general contractor as a carpenter, painter and electrician, Teacher A also built his own home.

In relation to his activities in the construction cluster, Teacher A exhibited outstanding leadership, enthusiasm, initiative, and teaching qualities. He encouraged his students to succeed in various areas of construction. In doing so, most of the manipulative tasks of the first year's program were successfully performed. See the task evaluation chart of student competencies at end of this section.

Throughout the school year Teacher A was faced with shortages of supplies, equipment, and materials needed for his program. Through his efforts and those of his principal, the resources of the county, the community, and the school system were utilized in order to secure the necessary materials needed to conduct the cluster program. Several building supply dealers furnished plumbing fixtures and used lumber free of charge. In cases where needed, tools and materials could not be obtained any other way, the principal of School A procured them with emergency requisitions.

Physical facilities. Eighteen boys were enrolled in the construction cluster in School A. The class met in the agricultural laboratory and utilized the equipment in this facility. This laboratory was of adequate size to accommodate the class, but because this facility was also used by the agricultural classes, there was not enough space for storage of tools and supplies.

In order to provide the needed storage space and additional work area, the first project of the construction cluster class was to build a 24' x 24' building adjacent to the laboratory. This building also had a 24' x 24' concrete slab adjacent to it which was utilized as a work area when the weather permitted.

At the start of the 1967-1968 school year, none of the tools, equipment,and materials recommended by the cluster concept project research team as necessary to conduct an effective program had been received by Teacher A. A status survey of tools, materials,and equipment revealed that during the course of the 1967-1968 school year, approximately 25 percent of the recommended items were obtained. It should be noted that this 25 percent does not include the tools and materials needed to construct the storage building. The tools and materials needed for this project were obtained on an emergency requisition through the cooperation of the principal of School A.

A detailed drawing of the laboratory in which the construction cluster was conducted is shown at the end of this section. This drawing also indicates major pieces of equipment and shows their location in the laboratory. See Illustration 1.

Instruction. The first several weeks of school were spent orienting the students to the program, developing basic tool skills, and planning and designing the 24' x 24' storage building. The students enrolled in the construction cluster constructed this building during the course of the school year. This building was erected adjacent to the construction laboratory and was used to store equipment and material utilized in the course.

The students dug a trench for the footing, poured the footing, laid concrete block, and erected the frame building. Students also shingled the roof and applied wooden siding. This structure was painted and gutters were added. In addition to the building, a 24' x 24' concrete slab was poured to be used for masonry work when the weather allowed.

In addition to activities in the carpentry area, experience in the painting area was obtained by having students paint several rooms in the school, including the principal's office, the teachers' room, and the industrial arts laboratory.

The class also constructed a full scale corner section of a house which was used for plumbing and electricity exercises.

During the latter part of the school year the students were divided into groups of three or four individuals and pursued their assignments in small groups by laying cement block and performing other masonry tasks. Other groups of students worked in the area of plumbing and electricity.

During class time another group of students aided a private individual in constructing a garage at a site adjacent to school property. This was done with the full approval of the principal and teacher and provided an on-the-job experience for the students.

In the course of the year, individual students constructed several small projects. These projects were designed to develop certain tool skills and experience while also constructing an item which could be utilized for instructional purposes. Examples of such projects included saw horses, forms for concrete work, and the construction and wiring of an electrical panel.

In order to evaluate the performance of each student enrolled in the construction cluster a task inventory was developed. This inventory listed the tasks to be taught in the construction cluster as developed in phase I of the cluster concept project. When kept up-to-date, it represented a record of student progress and growth to teachers, parents, pupils, and frequently, to employers.

Task evaluation charts located at the end of this section are of two types. One list indicates the tasks which were to be taught in the cluster concept program. Those tasks taught this year are indicated by a check (✓). Those tasks taught this year which the teacher feels need to be retaught next year, are indicated by a double check mark (✓✓). See Figure 9.

The second task evaluation chart indicated, in the teacher's opinion, how each student in his class performed the task. Each student received either a satisfactory (S) or unsatisfactory (U) as an evaluation of his achievement. Those tasks not taught during the first year of pilot programs were indicated by the letter (N). See Figure 10.

Community involvement. Through the efforts of Teacher A, the community became involved in the construction cluster. Local suppliers of building equipment developed an interest in the program and donated materials which were utilized in the area of carpentry and plumbing. Community involvement in the cluster program was also evident by the fact that between 85 and 90 percent of the class was able to find employment during the summer in one of the occupations of the cluster.

A visual summary of the preceding five areas, administration, teacher, physical facilities, instruction, and community involvement, which have been featured in the description of the pilot program at School A, is presented in Figure 11.

Summary and Recommendations

The group of students in School A was provided with rich and varied experiences in all the areas taught in the construction cluster. Due to the interest and guidance of Teacher A this group received the most varied experiences when compared with other schools teaching the construction cluster.

The program at School A could have been substantially improved had all the necessary tools, materials, equipment and textbooks been available to the teacher for the majority of the school year. Teacher A was also handicapped by having to use the facilities of the vocational-agriculture department for practical work throughout the winter, and during inclement weather. This could have been a very serious drawback had there not been remarkable cooperation between the personnel involved. Since it would be impossible to construct another building the size of the storage facility which was built during the first year of the pilot program, other avenues must be sought for obtaining this type of practical experience during the second year of the program. Near the end of the year Teacher A began experimenting with individual and small group work stations which may be a solution to this problem.

SCHOOL A

CONSTRUCTION CLUSTER

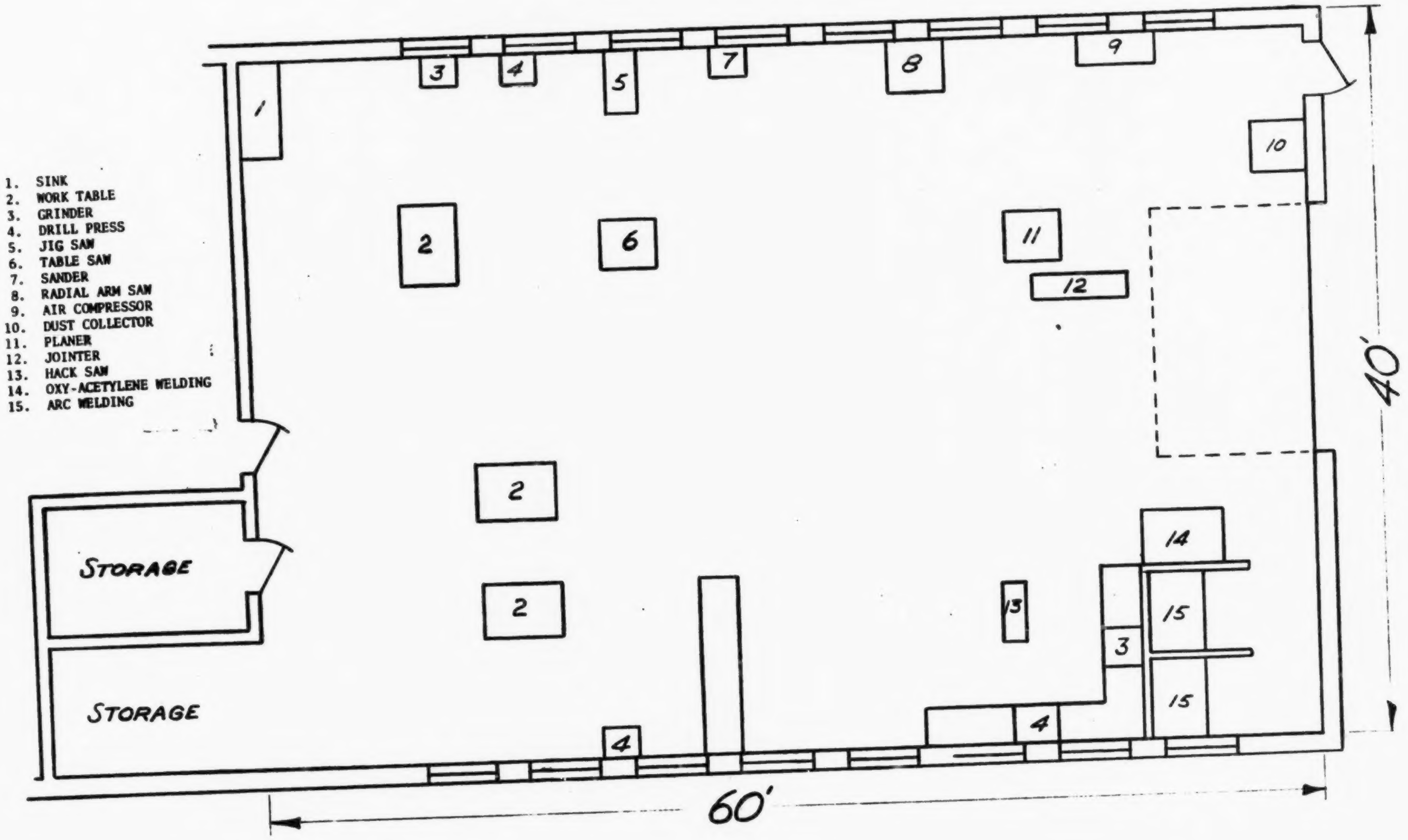

1. SINK
2. WORK TABLE
3. GRINDER
4. DRILL PRESS
5. JIG SAW
6. TABLE SAW
7. SANDER
8. RADIAL ARM SAW
9. AIR COMPRESSOR
10. DUST COLLECTOR
11. PLANER
12. JOINTER
13. HACK SAW
14. OXY-ACETYLENE WELDING
15. ARC WELDING
STORAGE
STORAGE
40'
60'
1
2
2
2
3
3
4
4
4
5
6
7
8
9
10
11
12
13
14
15
15

ILLUSTRATION I

CARPENTRY EXPERIENCES

Level	Task No.	Task Statement	
I	1	Mixing mortar for mudsills of a house.	✓
I	2	Constructing a saw horse and a trestle for use on construction site.	✓✓
II	3	Cutting building material to length for a house.	✓
I	4	Erecting girders and columns for a house.	
II	5	Framing a box sill for a house.	✓✓
I	6	Installing hangers and anchors for floor joists for a house.	✓✓
II	7	Erecting floor and ceiling framing joists for a house.	✓✓
I	8	Installing cross bridging between floor joists for a house.	✓✓
I	9	Installing solid bridging between floor joists for a house.	✓✓
I	10	Laying subfloors on floor joists for a house.	✓✓
II	11	Framing bathroom floors for a tile floor in a house.	
II	12	Building up corner posts for corner of framing in a house.	✓✓
II	13	Laying out stud spacing for walls and partition.	✓✓
II	14	Assembling walls and partitions for a frame house.	✓
II	15	Erecting wall sections for a house.	✓
I	16	Applying lap, plywood or composition sheathing for a house.	✓
I	17	Installing fire stops along plate in a house.	✓✓
II	18	Installing staging brackets for house construction.	
II	19	Installing single and double post scaffolding for house construction.	✓✓
II	20	Framing a flat roof for a house.	
II	21	Installing gable studs for a house.	✓✓
I	22	Laying roof decking for a house.	✓
I	23	Applying building paper to sidewall, rough floor or roof deck on a house.	✓
I	24	Building a foot rest for shingling a roof on a house.	
II	25	Installing metal drip edge on roof for a house.	✓✓
I	26	Applying roll roofing for a house.	
II	27	Applying sheet metal roofing to a house.	
II	28	Applying built-up roofing to a house.	
II	29	Installing a hanging gutter to a house roof.	✓
II	30	Fastening wood to masonry with fasteners in a house.	
I	31	Installing blanket, bulk, batt, rigid and metallic insulation in a house.	
I	32	Installing backing to an interior wall of a house.	
I	33	Applying commercial wall board to the interior of a house.	
II	34	Installing furring and grounds to interior of a house.	
I	35	Applying lath to house studding.	
II	36	Applying corner boards on a house.	✓✓
II	37	Assembling basement stairs for a house.	
II	38	Erecting roof and deck framing for a house porch.	
II	39	Laying porch floors for a house.	

ELECTRICITY EXPERIENCES

Level	Task No.	Task Statement	
I	1	Installing boxes for receptacles, switches, junctions and fixtures in a house.	✓✓
I	2	Installing wiring from box to box in a house.	✓✓
I	3	Connecting receptacles, single throw switches, fixtures and pilot lights to complete circuits in a house.	✓✓
II	4	Erecting a temporary service pole for portable electric equipment used in building	

Figure 9.

Level	Task No.	Task Statement	
I	5	Installing rigid, thin wall and flexible conduit in a house.	
II	6	Installing a separate circuit for an electric range in a house.	
II	7	Installing grounds for a house wiring system.	
II	8	Installing entrance cable on the exterior of a house.	
II	9	Installing low voltage operated bells and signalling devices in a house.	✓✓
II	10	Connecting a hot water heater to a power source in a house.	
II	11	Connecting a water pump to a power source in a house.	
II	12	Installing an attic fan or room cooler in a house.	
		MASONRY EXPERIENCES	
I	1	Setting up a work area in order to expedite the mixing of concrete on the job.	✓
I	2	Cleaning and oiling concrete forms prior to and afer their use on a building.	✓
II	3	Preparing a batch of cement, plaster, lime mortar and cement-lime mortar by hand and by machine at the construction site.	✓
I	4	Shoring sidewalls of earthen ditches to prevent cave-ins during excavation.	
II	5	Installing rods and spreaders to space form section before pouring cement.	
I	6	Wiring and bolting forms to prevent spreading during pouring.	
II	7	Bracing sidewalls of forms to prevent spreading during pouring.	✓✓
I	8	Installing anchor bolts in masonry walls and concrete to provide a place for securing future construction.	✓
I	9	Protecting a concrete slab following finishing operations to provide for proper curing.	✓
I	10	Erecting scaffolding for use by a mason at the building site.	
I	11	Cleaning out mortar joints for tuck pointing on a masonry wall.	
I	12	Pointing up a section of a brick wall to provide a finished appearance on a house.	✓
I	13	Applying colorless coating to waterproof masonry surfaces above grade on a building.	
I	14	Applying asphalt coating to waterproof foundation wall below grade on a building.	
I	15	Pouring a section of footing containing reinforcing rods for a house.	✓
I	16	Pouring a small reinforced concrete slab suitable for a porch deck on a house.	✓
II	17	Installing footer forms to receive concrete for a foundation.	✓✓
II	18	Setting a section of sidewalk form to receive concrete at a building site.	✓✓
II	19	Finishing a small concrete slab to provide utility and pleasing appearance.	✓
II	20	Laying cement block for a wall in stretcher courses for a building.	✓
		PAINTING EXPERIENCES	
I	1	Preparing a surface for application of stain on the interior or exterior of a house.	✓✓
I	2	Preparing a surface for application of paint on the interior or exterior of a house.	✓
II	3	Preparing a surface for application of a clear finish on the interior or exterior of a house.	✓✓
I	4	Removing old finishes in preparation for resurfacing.	✓✓
I	5	Preparing stain and applicator for use on the interior and exterior of a house.	✓
II	6	Preparing paint and applicator for use in painting a house.	✓
I	7	Preparing clear finishes and applicators for use on the exterior and interior of a house.	✓✓
I	8	Cleaning and storing brushes and rollers following their use in applying finishing materials.	✓
I	9	Glazing a window in preparation for painting.	
I	10	Preparing joints and nail holes in dry wall construction to receive final finish.	
I	11	Applying finishing materials to provide protection and decoration of surfaces in or on a house.	✓

Figure 9, continued

PLUMBING EXPERIENCES

Level	Task No.	Task Statement	
I	1	Digging a trench for plumbing installation in a house.	
I	2	Backfilling a trench following installation of plumbing lines for a house.	
I	3	Preparing copper tubing for installation in a plumbing system for a house.	✓✓
I	4	Preparing pipe for installation in a plumbing or gas supply system in a house.	✓✓
I	5	Preparing cast iron soil pipe to pour a lead joint for a waste line in a house.	✓✓
I	6	Preparing lead for pouring soil pipe joints for a house.	✓
I	7	Laying a drainage field with clay pipe for a house.	
I	8	Attaching mounting brackets for plumbing fixtures to frame construction.	✓
I	9	Attaching mounting brackets for plumbing fixtures to masonry construction.	
I	10	Installing a water closet seat in a house.	
I	11	Insulating heating and water lines in a house.	
I	12	Assembling a furnace for a house.	
I	13	Installing duct work for warm air heating system in a house.	
II	14	Installing plastic pipe for plumbing lines for a house.	
II	15	Soldering sheet metal and copper tubing to be used in a house.	✓
II	16	Repairing leaks in faucets in a house.	✓
II	17	Repairing leaks in a water closet in a house.	
II	18	Cleaning waste lines with a snake in a house.	
I	19	Welding angle iron for pipe hangers.	

Figure 9, continued

CARPENTRY EXPERIENCES

Student

Level	Task No.	Task Statement	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V
I	1	Mixing mortar for mudsills of a house.	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S				
I	2	Constructing a saw horse and a trestle for use on construction site.	S	S	U	S	U	S	U	U	U	U	U	U	U	U	U	U	S	S				
II	3	Cutting building material to length for a house.	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S				
I	4	Erecting girders and columns for a house.	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N				
II	5	Framing a box sill for a house.	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U				
I	6	Installing hangers and anchors for floor joists for a house.	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U				
II	7	Erecting floor and ceiling framing joists for a house.	U	U	S	S	S	S	U	U	U	S	S	S	S	S	S	S	S	U				
I	8	Installing cross bridging between floor joists for a house.	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U				
I	9	Installing solid bridging between floor joists for a house.	U	U	U	U	U	S	U	U	U	U	U	U	U	U	S	U	U	U				
I	10	Laying subfloors on floor joists for a house.	U	U	U	U	U	S	U	U	U	U	U	S	U	U	S	U	U	U				
II	11	Framing bathroom floors for a tile floor in a house.	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N				
II	12	Building up corner posts for corner of framing in a house.	S	U	S	S	S	S	U	U	S	S	U	U	S	S	S	U	S	S				
II	13	Laying out stud spacing for walls and partition.	S	S	S	S	S	S	U	U	U	U	S	S	S	S	S	S	S	S				
II	14	Assembling walls and partitions for a frame house.	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S				
II	15	Erecting wall sections for a house.	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S				
I	16	Applying lap, plywood or composition sheathing for a house.	U	S	U	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S				
I	17	Installing fire stops along plate in a house.	U	U	U	S	U	U	U	U	S	U	S	U	U	S	S	U	U	U				
II	18	Installing staging brackets for house construction.	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N				
II	19	Installing single and double post scaffolding for house construction.	U	U	S	S	S	S	S	S	U	U	U	S	S	S	S	S	S	U				
II	20	Framing a flat roof for a house.	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N				

Figure 10.

Student

Level	Task No.	Task Statement	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V
II	21	Installing gable studs for a house.	U	U	S	S	S	S	U	U	U	S	S	U	U	U	S	S	U	S				
I	22	Laying roof decking for a house.	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S				
I	23	Applying building paper to sidewall, rough floor or roof deck on a house.	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S				
I	24	Building a foot rest for shingling a roof on a house.	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N				
II	25	Installing metal drip edge on roof for a house.	U	U	S	S	S	U	U	U	S	U	U	S	U	U	S	S	U	S				
I	26	Applying roll roofing for a house.	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N				
II	27	Applying sheet metal roofing to a house.	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N				
II	28	Applying built-up roofing to a house.	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N				
II	29	Installing a hanging gutter to a house roof.	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S				
II	30	Fastening wood to masonry with fasteners in a house.	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N				
I	31	Installing blanket, bulk, batt, rigid and metallic insulation in a house.	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N				
I	32	Installing backing to an interior wall of a house.	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N				
I	33	Applying commercial wall board to the interior of a house.	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N				
II	34	Installing furring and grounds to interior of a house.	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N				
I	35	Applying lath to house studding.	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N				
II	36	Applying corner boards on a house.	U	U	S	S	S	S	S	S	U	U	S	U	U	U	S	S	U	U				
II	37	Assembling basement stairs for a house.	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N				
II	38	Erecting roof and deck framing for a house porch.	N	N	N	U	N	U	N	N	N	N	N	N	N	N	N	N	N	N				
II	39	Laying porch floors for a house.	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N				
		ELECTRICITY EXPERIENCES																						
I	1	Installing boxes for receptacles, switches, junctions and fixtures in a house.	U	U	S	S	S	S	U	U	U	U	U	U	S	S	S	S	S	U				
I	2	Installing wiring from box to box in a house.	U	U	S.	S	U	S	U	U	U	U	U	U	U	S	S	S	U	U				
I	3	Connecting receptacles, single throw switches, fixtures and pilot lights to complete circuits in a house.	U	U	S	S	U	S	U	U	U	U	U	U	U	S	S	S	S	U				
II	4	Erecting a temporary service pole for portable electric equipment used in building	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N				

Figure 10, continued

			Student																				
Level	Task No.	Task Statement	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V
I	5	Installing rigid, thin wall and flexible conduit in a house.	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N				
II	6	Installing a separate circuit for an electric range in a house.	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N				
II	7	Installing grounds for a house wiring system.	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N				
II	8	Installing entrance cable on the exterior of a house.	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N				
II	9	Installing low voltage operated bells and signalling devices in a house.	U	U	S	S	U	S	S	U	S	U	U	S	U	U	S	S	S	U				
II	10	Connecting a hot water heater to a power source in a house.	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N				
II	11	Connecting a water pump to a power source in a house.	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N				
II	12	Installing an attic fan or room cooler in a house.	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N				
		MASONRY EXPERIENCES																						
I	1	Setting up a work area in order to expedite the mixing of concrete on the job.	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S				
I	2	Cleaning and oiling concrete forms prior to and afer their use on a building.	S	S	S	S	S	S	S	S	S	S	U	S	S	S	S	S	S	U				
II	3	Preparing a batch of cement, plaster, lime mortar and cement-lime mortar by hand and by machine at the construction site.	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S				
I	4	Shoring sidewalls of earthen ditches to prevent cave-ins during excavation.	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N				
II	5	Installing rods and spreaders to space form section before pouring cement.	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N				
I	6	Wiring and bolting forms to prevent spreading during pouring.	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N				
II	7	Bracing sidewalls of forms to prevent spreading during pouring.	U	U	S	U	S	S	U	S	U	U	U	U	U	U	S	S	U	S				
I	8	Installing anchor bolts in masonry walls and concrete to provide a place for securing future construction.	S	S	S	S	S	S	S	S	S	S	U	U	U	U	S	S	S	S				
I	9	Protecting a concrete slab following finishing operations to provide for proper curing.	U	U	S	S	S	S	S	S	S	U	S	S	S	S	S	S	S	S				
I	10	Erecting scaffolding for use by a mason at the building site.	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N				
I	11	Cleaning out mortar joints for tuck pointing on a masonry wall.	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N				

Figure 10, continued

			Student																					
Level	Task No.	Task Statement	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V
I	12	Pointing up a section of a brick wall to provide a finished appearance on a house.	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S				
I	13	Applying colorless coating to waterproof masonry surfaces above grade on a building.	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N				
I	14	Applying asphalt coating to waterproof foundation wall below grade on a building.	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N				
I	15	Pouring a section of footing containing reinforcing rods for a house.	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S				
I	16	Pouring a small reinforced concrete slab suitable for a porch deck on a house.	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S				
II	17	Installing footer forms to receive concrete for a foundation.	U	U	U	U	S	U	U	S	U	U	U	S	S	U	S	U	U	U				
II	18	Setting a section of sidewalk form to receive concrete at a building site.	S	U	S	S	S	S	S	U	U	U	U	U	U	U	S	S	U	S				
II	19	Finishing a small concrete slab to provide utility and pleasing appearance.	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S				
II	20	Laying cement block for a wall in stretcher courses for a building.	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S				
		PAINTING EXPERIENCES																						
I	1	Preparing a surface for application of stain on the interior or exterior of a house.	U	S	S	U	U	S	U	U	U	S	U	S	S	U	S	U	S	S				
I	2	Preparing a surface for application of paint on the interior or exterior of a house.	S	S	[illegible]	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S				
II	3	Preparing a surface for application of a clear finish on the interior or exterior of a house.	U	U	U	[illegible]	U	S	U	U	U	U	U	U	U	U	S	U	U	U				
I	4	Removing old finishes in preparation for resurfacing.	U	U	U	U	U	S	S	U	S	U	U	U	U	U	S	U	U	U				
I	5	Preparing stain and applicator for use on the interior and exterior of a house.	S	S	S	U	U	S	S	U	S	S	U	S	S	U	S	U	S	U				
II	6	Preparing paint and applicator for use in painting a house.	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S				
I	7	Preparing clear finishes and applicators for use on the exterior and interior of a house.	U	U	U	S	U	S	U	U	U	U	U	U	U	U	U	U	U	U				
I	8	Cleaning and storing brushes and rollers following their use in applying finishing materials.	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S				
I	9	Glazing a window in preparation for painting.	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N				
1	10	Preparing joints and nail holes in dry wall construction to receive final finish.	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N				
I	11	Applying finishing materials to provide protection and decoration of surfaces in or on a house.	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	U	S	S				

Figure 10, continued

PLUMBING EXPERIENCES

Level	Task No.	Task Statement	Student																					
			A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V
I	1	Digging a trench for plumbing installation in a house.	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N				
I	2	Backfilling a trench following installation of plumbing lines for a house.	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N				
I	3	Preparing copper tubing for installation in a plumbing system for a house.	U	U	S	S	S	S	U	U	U	U	S	S	S	S	S	S	U	S				
I	4	Preparing pipe for installation in a plumbing or gas supply system in a house.	U	U	S	S	S	S	U	U	U	S	S	U	S	S	S	S	S	S				
I	5	Preparing cast iron soil pipe to pour a lead joint for a waste line in a house.	S	S	S	S	S	S	S	U	U	S	S	S	S	S	S	S	U	S				
I	6	Preparing lead for pouring soil pipe joints for a house.	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S				
I	7	Laying a drainage field with clay pipe for a house.	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N				
I	8	Attaching mounting brackets for plumbing fixtures to frame construction.	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S				
I	9	Attaching mounting brackets for plumbing fixtures to masonry construction.	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N				
I	10	Installing a water closet seat in a house.	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S				
I	11	Insulating heating and water lines in a house.	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N				
I	12	Assembling a furnace for a house.	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N				
I	13	Installing duct work for warm air heating system in a house.	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N				
II	14	Installing plastic pipe for plumbing lines for a house.	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N				
II	15	Soldering sheet metal and copper tubing to be used in a house.	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S				
II	16	Repairing leaks in faucets in a house.	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S				
II	17	Repairing leaks in a water closet in a house.	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N				
II	18	Cleaning waste lines with a snake in a house.	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N				
I	19	Welding angle iron for pipe hangers.	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N				

Figure 10, continued

SUMMARY-EVALUATION OF CLUSTER CONCEPT PILOT PROGRAM

SCHOOL A

	1	2	3	4	5
ADMINISTRATION	The school and county administrative personnel provided minimal moral and material support to the program and the teacher.		The school and county administrative personnel actively supported the program by furnishing the teacher with moral support but with less than satisfactory material support.		The school and county administrative personnel actively supported the program by furnishing the teacher with adequate moral and material support.
TEACHER	Little academic preparation in major field. Little or no teaching experience or practical experience in major field. Seldom shows resourcefulness or initiative.		Adequate academic preparation in major field. Has some teaching experience and some practical experience in major field. Sometime shows resourcefulness and initiative.		Superior academic preparation in major field. An experienced teacher with practical experience in major field. Resourceful. An initiator.
PHYSICAL FACILITIES	The size of the laboratory is inadequate and severely restricts occupational activities. The program also suffers from lack of equipment.		The size of the laboratory is adequate but somewhat restricts occupational activities. The laboratory has the minimum amount of equipment for operating the cluster program.		Size of the laboratory allows unrestricted occupational activities. The laboratory is suitably equipped for the cluster program.
INSTRUCTION	Tasks were taught in only one or two occupations. A very restricted number of Level I tasks were performed by the students. Few experiences offered were appropriate to the cluster.		Tasks were taught in several occupations. A majority of Level I tasks were performed by the students. Experiences were not always appropriate to occupations in the cluster.		Tasks were taught in all occupations. Most Level I tasks were performed by the students. Student experiences were extremely appropriate to occupations in the cluster.
COMMUNITY INVOLVEMENT	Community organizations were unaware of, or did not support the cluster program. Little opportunity for employment was evident in the community.		Community organizations furnished some support to the cluster program. Some members of the class found employment opportunity in the community.		Community organizations cooperated by furnishing aid to the program. A large proportion of the class found employment opportunity in the community.

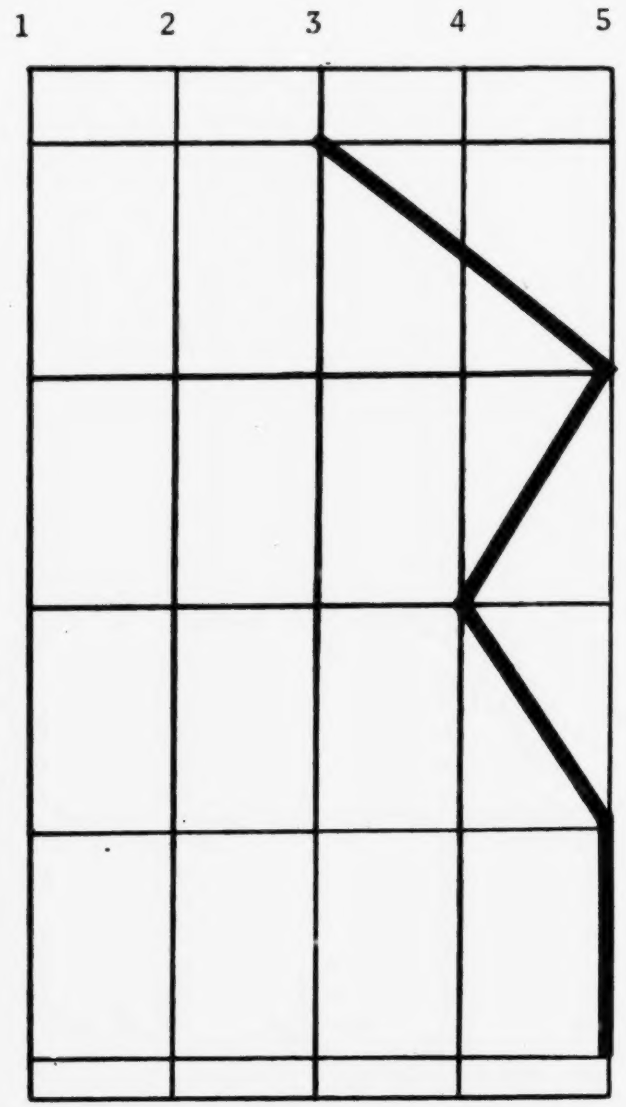


Figure 11.

Orientation. School C was located in a rural setting and was composed of grades 7 through 12. The school program consisted of basic general education for grades 7 and 8. Students entering grade 9 selected a program to be followed for the remainder of their high school career. The students selected either the college entrance, business, or general curriculum.

The introduction of the construction cluster into this school added another dimension to the practical arts curriculum. In addition to the construction cluster the other practical areas of the curriculum included courses in business, home economics, and industrial arts.

The administration. The principal of School C gave his full support to the cluster concept program in his school. Both he and the guidance counselor aided Teacher C with problems involving scheduling of class time and students.

The county administration favored the cluster concept program and provided Teacher C with some of the materials and equipment he needed in order to conduct his program. Very little of this material and equipment was received during the first semester.

The supervisor of industrial education met with members of the research team and with the principal investigator on various occasions to discuss the progress of cluster programs in his county. He was particularly solicitous of the problems encountered by Teacher C in operating his pilot program.

The teacher. Teacher C held a B.S. degree in Agriculture with a major in Horticulture. He had several years experience with a producer's cooperative, followed by four and one-half years military service as an ordnance instructor of automotives, as well as tank electrical systems.

Following World War II he enrolled in graduate school in order to obtain certification to teach vocational agriculture. Teacher C has had two and one-half years experience teaching agriculture and fifteen years experience as an industrial arts instructor.

Physical facilities. In School C fourteen boys were enrolled in the construction cluster. The class met in the industrial arts laboratory and utilized the equipment in this facility. This laboratory was large enough to accommodate a class of this size, but this facility was also used by industrial arts classes. The construction of a small building within the laboratory resulted in a substantial reduction of the work area and created some storage problems.

At the start of the 1967-1968 school year, none of the materials and equipment ordered for the cluster concept program was on hand. Teacher C was able to carry the program through the first semester with the tools and materials used in his regular industrial arts program. During the course of the school year approximately 35 percent of the recommended tools, equipment, and materials were received. In addition, all materials needed to construct an 8' x 10' refreshment stand were also received.

A detailed drawing of the laboratory in which the construction cluster was conducted is shown at the end of this section. This drawing also indicates major pieces of equipment and shows their location in the laboratory. See illustration 2.

Instruction. The first three months of the school year were spent orienting the students to the program, developing basic tool skills, and performing exercises in various areas of the construction cluster, such as cutting, reaming, and threading pipe, constructing saw horses, and wiring various types of electrical circuits. In addition to these activities, the class designed an 8' x 10' refreshment stand. The students enrolled in the construction cluster constructed this structure during the second semester of the school year. The laboratory had a 10' overhead door, and the refreshment stand was constructed in front of this door. The structure was built on skids which enabled the class to slide the unit outdoors and work on it when the weather allowed.

In addition to framing the structure, other carpentry experiences included the application of exterior siding, shingling the roof, installation of windows and door, and the application of trim. The construction of this structure also provided students with experiences in the areas of electricity and painting.

Upon completion, the building was moved to the athletic field where it became a permanent structure used as a refreshment stand during athletic events.

During the course of the year individual students constructed several small projects, items for use in the laboratory, or repaired various pieces of school equipment. These activities were approved by the instructor only if he felt the student gained experience and skill by performing the assignment. Typical activities included the construction of a tool panel to house masonry equipment, the repairing of athletic benches, and the construction of gym equipment which incorporated the cutting, reaming, and threading of pipe, along with several other plumbing tasks.

In order to evaluate the performance of each student enrolled in the construction cluster, a task inventory was developed. This inventory listed all the tasks to be taught in the construction cluster as developed in phase I of the cluster concept project. When kept up-to-date, it represented a record of student progress and achievement to teachers, parents, pupils, and in some cases, employers.

The task evaluation charts located at the end of this section are of two types. One list indicates the tasks which were to be taught in the cluster concept program. Those tasks taught this year are indicated by a check (✓). Those tasks taught this year which the teacher feels need to be retaught next year are indicated by a double check mark (✓✓). See Figure 12.

The second evaluation chart indicated,in the teacher's opinion, how each student in his class performed the task. Each student received either a satisfactory (S) or unsatisfactory (U) as an evaluation of his achievement. Those tasks not taught during the first year of pilot programs were indicated by the letter (N). See Figure 13.

Community involvement. Community involvement in the construction cluster at School C was rather limited. Teacher C was able to obtain some used brick to be used for masonry exercises from a local construction company.

The building of an addition to School C provided the class many opportunities to view various activities involved in commerical construction, while not having to leave school property.

A visual summary of the preceding five areas, administration, teacher, physical facilities, instruction, and community involvement, which have been featured in the description of the pilot program at School C, is presented in Figure 14.

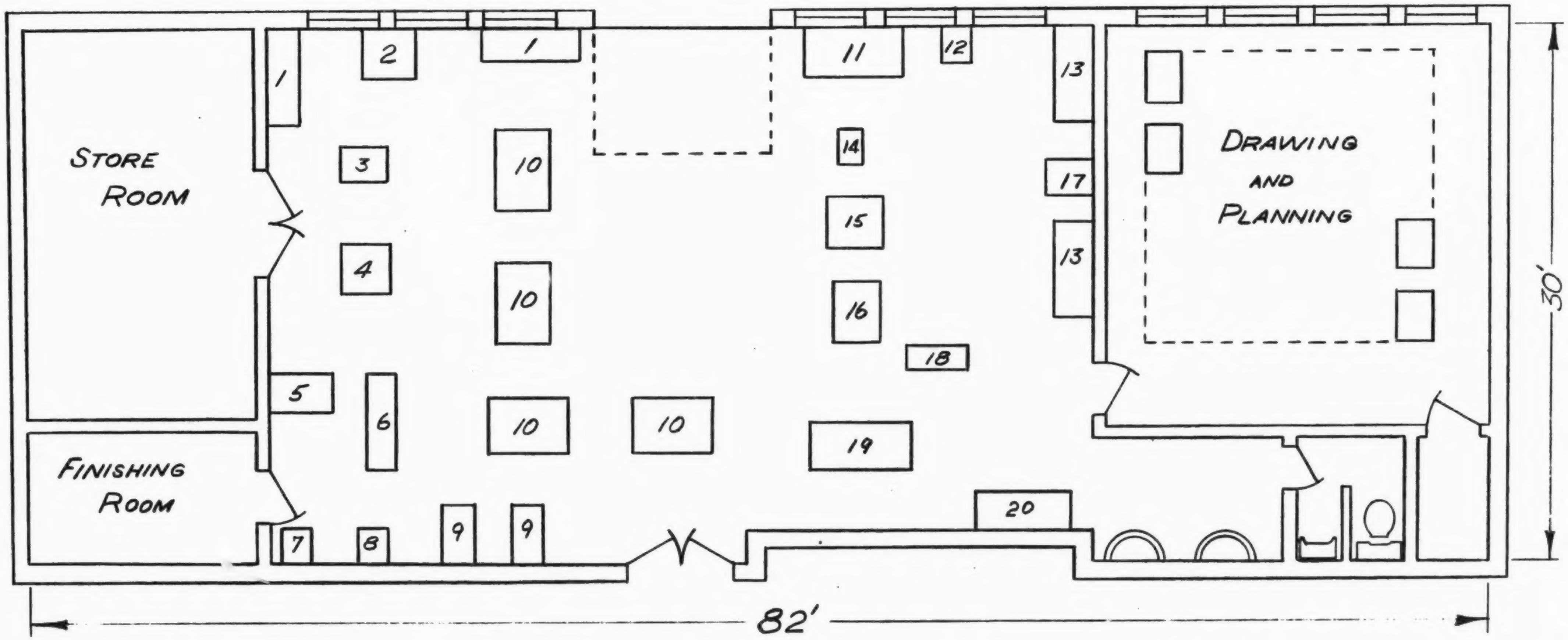
Summary and recommendations. The students in School C were provided broad experiences in the areas of carpentry and plumbing, with rather limited experiences provided in the areas of electricity and painting. Little experience was provided in the masonry area.

The program at School C would have been improved if more experience in the areas of electricity, painting, and masonry had been provided. More space in the laboratory would provide areas where these activities could be carried on.

Diversified experiences in carpentry were provided, but since a structure similar to the refreshment stand cannot be built every year, another vehicle to obtain the necessary practical experience must be found.

SCHOOL C

CONSTRUCTION CLUSTER


STORE ROOM
FINISHING ROOM
DRAWING AND PLANNING
1
2
1
11
12
13
3
10
14
17
4
10
15
13
16
18
5
6
10
10
19
20
7
8
9
9
30'
82'

1. WOOD LATHE
2. RADIAL ARM SAW
3. PLANER
4. TABLE SAW
5. BAND SAW
6. JOINTER
7. DRILL PRESS
8. GRINDER
9. JIG SAW
10. WORK BENCH
11. ARC WELDER
12. GRINDER
13. METAL LATHE
14. SQUARING SHEARS
15. MILLING MACHINE
16. SHEET METAL MACHINES
17. DRILL PRESS
18. HACK SAW
19. SOLDERING BENCH
20. ELECTRICAL TEST BENCH

ILLUSTRATION 2

CARPENTRY EXPERIENCES

Level	Task No.	Task Statement	
I	1	Mixing mortar for mudsills of a house.	
I	2	Constructing a saw horse and a trestle for use on construction site.	
II	3	Cutting building material to length for a house.	✓
I	4	Erecting girders and columns for a house.	✓✓
II	5	Framing a box sill for a house.	✓✓
I	6	Installing hangers and anchors for floor joists for a house.	✓✓
II	7	Erecting floor and ceiling framing joists for a house.	✓✓
I	8	Installing cross bridging between floor joists for a house.	✓✓
I	9	Installing solid bridging between floor joists for a house.	✓
I	10	Laying subfloors on floor joists for a house.	✓
II	11	Framing bathroom floors for a tile floor in a house.	
II	12	Building up corner posts for corner of framing in a house.	✓
II	13	Laying out stud spacing for walls and partition.	✓✓
II	14	Assembling walls and partitions for a frame house.	✓
II	15	Erecting wall sections for a house.	✓
I	16	Applying lap, plywood or composition sheathing for a house.	✓
I	17	Installing fire stops along plate in a house.	✓
II	18	Installing staging brackets for house construction.	
II	19	Installing single and double post scaffolding for house construction.	
II	20	Framing a flat roof for a house.	

Level	Task No.	Task Statement	
II	21	Installing gable studs for a house.	✓✓
I	22	Laying roof decking for a house.	✓
I	23	Applying building paper to sidewall, rough floor or roof deck on a house.	✓
I	24	Building a foot rest for shingling a roof on a house.	
II	25	Installing metal drip edge on roof for a house.	✓
I	26	Applying roll roofing for a house.	✓
II	27	Applying sheet metal roofing to a house.	
II	28	Applying built-up roofing to a house.	
II	29	Installing a hanging gutter to a house roof.	
II	30	Fastening wood to masonry with fasteners in a house.	✓
I	31	Installing blanket, bulk, batt, rigid and metallic insulation in a house.	✓
I	32	Installing backing to an interior wall of a house.	
I	33	Applying commercial wall board to the interior of a house.	
II	34	Installing furring and grounds to interior of a house.	
I	35	Applying lath to house studding.	
II	36	Applying corner boards on a house.	✓✓
II	37	Assembling basement stairs for a house.	
II	38	Erecting roof and deck framing for a house porch.	
II	39	Laying porch floors for a house.	

ELECTRICITY EXPERIENCES

Level	Task No.	Task Statement	
I	1	Installing boxes for receptacles, switches, junctions and fixtures in a house.	✓
I	2	Installing wiring from box to box in a house.	
I	3	Connecting receptacles, single throw switches, fixtures and pilot lights to complete circuits in a house.	✓✓
II	4	Erecting a temporary service pole for portable electric equipment used in building	

Figure 12.

Level	Task No.	Task Statement	
I	5	Installing rigid, thin wall and flexible conduit in a house.	☐
II	6	Installing a separate circuit for an electric range in a house.	☐
II	7	Installing grounds for a house wiring system.	☐
II	8	Installing entrance cable on the exterior of a house.	☐
II	9	Installing low voltage operated bells and signalling devices in a house.	☐
II	10	Connecting a hot water heater to a power source in a house.	☐
II	11	Connecting a water pump to a power source in a house.	☐
II	12	Installing an attic fan or room cooler in a house.	☐
		MASONRY EXPERIENCES	☐
I	1	Setting up a work area in order to expedite the mixing of concrete on the job.	☐
I	2	Cleaning and oiling concrete forms prior to and afer their use on a building.	☐
II	3	Preparing a batch of cement, plaster, lime mortar and cement-lime mortar by hand and by machine at the construction site.	☑
I	4	Shoring sidewalls of earthen ditches to prevent cave-ins during excavation.	☐
II	5	Installing rods and spreaders to space form section before pouring cement.	☐
I	6	Wiring and bolting forms to prevent spreading during pouring.	☐
II	7	Bracing sidewalls of forms to prevent spreading during pouring.	☐
I	8	Installing anchor bolts in masonry walls and concrete to provide a place for securing future construction.	☐
I	9	Protecting a concrete slab following finishing operations to provide for proper curing.	☐
I	10	Erecting scaffolding for use by a mason at the building site.	☐
I	11	Cleaning out mortar joints for tuck pointing on a masonry wall.	☐

Figure 12, continued

Level	Task No.	Task Statement	
I	12	Pointing up a section of a brick wall to provide a finished appearance on a house.	☐
I	13	Applying colorless coating to waterproof masonry surfaces above grade on a building.	☐
I	14	Applying asphalt coating to waterproof foundation wall below grade on a building.	☐
I	15	Pouring a section of footing containing reinforcing rods for a house.	☐
I	16	Pouring a small reinforced concrete slab suitable for a porch deck on a house.	☐
II	17	Installing footer forms to receive concrete for a foundation.	☐
II	18	Setting a section of sidewalk form to receive concrete at a building site.	☐
II	19	Finishing a small concrete slab to provide utility and pleasing appearance.	☐
II	20	Laying cement block for a wall in stretcher courses for a building.	☐
		PAINTING EXPERIENCES	☐
I	1	Preparing a surface for application of stain on the interior or exterior of a house.	☑
I	2	Preparing a surface for application of paint on the interior or exterior of a house.	☐
II	3	Preparing a surface for application of a clear finish on the interior or exterior of a house.	☐
I	4	Removing old finishes in preparation for resurfacing.	☐
I	5	Preparing stain and applicator for use on the interior and exterior of a house.	☐
II	6	Preparing paint and applicator for use in painting a house.	☐
I	7	Preparing clear finishes and applicators for use on the exterior and interior of a house.	☐
I	8	Cleaning and storing brushes and rollers following their use in applying finishing materials.	☑
I	9	Glazing a window in preparation for painting.	☑
I	10	Preparing joints and nail holes in dry wall construction to receive final finish.	☐
I	11	Applying finishing materials to provide protection and decoration of surfaces in or on a house.	☐

PLUMBING EXPERIENCES

Level	Task No.	Task Statement	
I	1	Digging a trench for plumbing installation in a house.	
I	2	Backfilling a trench following installation of plumbing lines for a house.	
I	3	Preparing copper tubing for installation in a plumbing system for a house.	✓
I	4	Preparing pipe for installation in a plumbing or gas supply system in a house.	✓
I	5	Preparing cast iron soil pipe to pour a lead joint for a waste line in a house.	✓
I	6	Preparing lead for pouring soil pipe joints for a house.	✓✓
I	7	Laying a drainage field with clay pipe for a house.	
I	8	Attaching mounting brackets for plumbing fixtures to frame construction.	
I	9	Attaching mounting brackets for plumbing fixtures to masonry construction.	
I	10	Installing a water closet seat in a house.	
I	11	Insulating heating and water lines in a house.	✓
I	12	Assembling a furnace for a house.	
I	13	Installing duct work for warm air heating system in a house.	
II	14	Installing plastic pipe for plumbing lines for a house.	✓
II	15	Soldering sheet metal and copper tubing to be used in a house.	✓
II	16	Repairing leaks in faucets in a house.	
II	17	Repairing leaks in a water closet in a house.	
II	18	Cleaning waste lines with a snake in a house.	✓✓
I	19	Welding angle iron for pipe hangers.	

Figure 12, continued

CARPENTRY EXPERIENCES

			Student																					
Level	Task No.	Task Statement	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V
I	1	Mixing mortar for mudsills of a house.	N	N	N	N	N	N	N	N	N	N	N	N										
I	2	Constructing a saw horse and a trestle for use on construction site.	N	N	N	N	N	N	N	N	N	N	N	N										
II	3	Cutting building material to length for a house.	S	S	S	S	S	S	S	S	S	S	S	S										
I	4	Erecting girders and columns for a house.	U	S	U	U	S	S	S	S	S	U	S	U										
II	5	Framing a box sill for a house.	U	S	S	U	U	U	S	U	S	S	U	S										
I	6	Installing hangers and anchors for floor joists for a house.	U	S	S	S	S	S	S	S	S	S	S	S										
II	7	Erecting floor and ceiling framing joists for a house.	U	S	U	U	U	S	S	U	S	U	U	U										
I	8	Installing cross bridging between floor joists for a house.	U	S	S	S	S	S	S	S	S	S	S	S										
I	9	Installing solid bridging between floor joists for a house.	U	S	S	S	S	S	S	S	S	S	S	S										
I	10	Laying subfloors on floor joists for a house.	S	S	S	S	S	S	S	S	S	S	S	S										
II	11	Framing bathroom floors for a tile floor in a house.	N	N	N	N	N	N	N	N	N	N	N	N										
II	12	Building up corner posts for corner of framing in a house.	S	S	S	S	S	S	S	S	S	S	S	S										
II	13	Laying out stud spacing for walls and partition.	S	U	S	U	S	U	S	U	S	U	U	S										
II	14	Assembling walls and partitions for a frame house.	U	S	S	S	S	U	S	S	S	S	S	S										
II	15	Erecting wall sections for a house.	U	S	S	S	S	S	S	S	S	S	S	S										
I	16	Applying lap, plywood or composition sheathing for a house.	S	S	S	S	S	S	S	S	S	S	S	S										
I	17	Installing fire stops along plate in a house.	S	S	S	S	S	S	S	S	S	S	S	S										
II	18	Installing staging brackets for house construction.	N	N	N	N	N	N	N	N	N	N	N	N										
II	19	Installing single and double post scaffolding for house construction.	N	N	N	N	N	N	N	N	N	N	N	N										
II	20	Framing a flat roof for a house.	N	N	N	N	N	N	N	N	N	N	N	N										

Figure 13.

			Student																					
Level	Task No.	Task Statement	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V
II	21	Installing gable studs for a house.	U	S	U	U	U	U	S	U	S	U	U	S										
I	22	Laying roof decking for a house.	U	S	S	S	S	U	S	S	S	S	S	S										
I	23	Applying building paper to sidewall, rough floor or roof deck on a house.	S	S	S	S	S	S	S	S	S	S	S	S										
I	24	Building a foot rest for shingling a roof on a house.	N	N	N	N	N	N	N	N	N	N	N	N										
II	25	Installing metal drip edge on roof for a house.	S	S	S	S	S	S	S	S	S	S	S	S										
I	26	Applying roll roofing for a house.	S	S	S	S	S	S	S	S	S	S	S	S										
II	27	Applying sheet metal roofing to a house.	N	N	N	N	N	N	N	N	N	N	N	N										
II	28	Applying built-up roofing to a house.	N	N	N	N	N	N	N	N	N	N	N	N										
II	29	Installing a hanging gutter to a house roof.	N	N	N	N	N	N	N	N	N	N	N	N										
II	30	Fastening wood to masonry with fasteners in a house.	S	S	S	S	S	S	S	S	S	S	S	S										
I	31	Installing blanket, bulk, batt, rigid and metallic insulation in a house.	S	S	S	S	S	S	S	S	S	S	S	S										
I	32	Installing backing to an interior wall of a house.	N	N	N	N	N	N	N	N	N	N	N	N										
I	33	Applying commercial wall board to the interior of a house.	N	N	N	N	N	N	N	N	N	N	N	N										
II	34	Installing furring and grounds to interior of a house.	N	N	N	N	N	N	N	N	N	N	N	N										
I	35	Applying lath to house studding.	N	N	N	N	N	N	N	N	N	N	N	N										
II	36	Applying corner boards on a house.	U	S	U	U	S	U	S	U	S	S	U	S										
II	37	Assembling basement stairs for a house.	N	N	N	N	N	N	N	N	N	N	N	N										
II	38	Erecting roof and deck framing for a house porch.	N	N	N	N	N	N	N	N	N	N	N	N										
II	39	Laying porch floors for a house.	N	N	N	N	N	N	N	N	N	N	N	N										
		ELECTRICITY EXPERIENCES																						
I	1	Installing boxes for receptacles, switches, junctions and fixtures in a house.	U	S	S	S	S	U	S	S	S	S	S	S										
I	2	Installing wiring from box to box in a house.	N	N	N	N	N	N	N	N	N	N	N	N										
I	3	Connecting receptacles, single throw switches, fixtures and pilot lights to complete circuits in a house.	U	S	U	U	U	U	S	U	S	U	U	U										
II	4	Erecting a temporary service pole for portable electric equipment used in building	N	N	N	N	N	N	N	N	N	N	N	N										

Figure 13, continued

			Student																					
Level	Task No.	Task Statement	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V
I	5	Installing rigid, thin wall and flexible conduit in a house.	N	N	N	N	N	N	N	N	N	N	N	N										
II	6	Installing a separate circuit for an electric range in a house.	N	N	N	N	N	N	N	N	N	N	N	N										
II	7	Installing grounds for a house wiring system.	N	N	N	N	N	N	N	N	N	N	N	N										
II	8	Installing entrance cable on the exterior of a house.	N	N	N	N	N	N	N	N	N	N	N	N										
II	9	Installing low voltage operated bells and signalling devices in a house.	N	N	N	N	N	N	N	N	N	N	N	N										
II	10	Connecting a hot water heater to a power source in a house.	N	N	N	N	N	N	N	N	N	N	N	N										
II	11	Connecting a water pump to a power source in a house.	N	N	N	N	N	N	N	N	N	N	N	N										
II	12	Installing an attic fan or room cooler in a house.	N	N	N	N	N	N	N	N	N	N	N	N										
		MASONRY EXPERIENCES																						
I	1	Setting up a work area in order to expedite the mixing of concrete on the job.	N	N	N	N	N	N	N	N	N	N	N	N										
I	2	Cleaning and oiling concrete forms prior to and afer their use on a building.	N	N	N	N	N	N	N	N	N	N	N	N										
II	3	Preparing a batch of cement, plaster, lime mortar and cement-lime mortar by hand and by machine at the construction site.	S	S	S	S	S	S	S	S	S	S	S	S										
I	4	Shoring sidewalls of earthen ditches to prevent cave-ins during excavation.	N	N	N	N	N	N	N	N	N	N	N	N										
II	5	Installing rods and spreaders to space form section before pouring cement.	N	N	N	N	N	N	N	N	N	N	N	N										
I	6	Wiring and bolting forms to prevent spreading during pouring.	N	N	N	N	N	N	N	N	N	N	N	N										
II	7	Bracing sidewalls of forms to prevent spreading during pouring.	N	N	N	N	N	N	N	N	N	N	N	N										
I	8	Installing anchor bolts in masonry walls and concrete to provide a place for securing future construction.	N	N	N	N	N	N	N	N	N	N	N	N										
I	9	Protecting a concrete slab following finishing operations to provide for proper curing.	N	N	N	N	N	N	N	N	N	N	N	N										
I	10	Erecting scaffolding for use by a mason at the building site.	N	N	N	N	N	N	N	N	N	N	N	N										
I	11	Cleaning out mortar joints for tuck pointing on a masonry wall.	N	N	N	N	N	N	N	N	N	N	N	N										

Figure 13, continued

Student

Level	Task No.	Task Statement	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V
I	12	Pointing up a section of a brick wall to provide a finished appearance on a house.	N	N	N	N	N	N	N	N	N	N	N	N										
I	13	Applying colorless coating to waterproof masonry surfaces above grade on a building.	N	N	N	N	N	N	N	N	N	N	N	N										
I	14	Applying asphalt coating to waterproof foundation wall below grade on a building.	N	N	N	N	N	N	N	N	N	N	N	N										
I	15	Pouring a section of footing containing reinforcing rods for a house.	N	N	N	N	N	N	N	N	N	N	N	N										
I	16	Pouring a small reinforced concrete slab suitable for a porch deck on a house.	N	N	N	N	N	N	N	N	N	N	N	N										
II	17	Installing footer forms to receive concrete for a foundation.	N	N	N	N	N	N	N	N	N	N	N	N										
II	18	Setting a section of sidewalk form to receive concrete at a building site.	N	N	N	N	N	N	N	N	N	N	N	N										
II	19	Finishing a small concrete slab to provide utility and pleasing appearance.	N	N	N	N	N	N	N	N	N	N	N	N										
II	20	Laying cement block for a wall in stretcher courses for a building.	N	N	N	N	N	N	N	N	N	N	N	N										
		PAINTING EXPERIENCES																						
I	1	Preparing a surface for application of stain on the interior or exterior of a house.	S	S	S	S	S	S	S	S	S	S	S	S										
I	2	Preparing a surface for application of paint on the interior or exterior of a house.	N	N	N	N	N	N	N	N	N	N	N	N										
II	3	Preparing a surface for application of a clear finish on the interior or exterior of a house.	N	N	N	N	N	N	N	N	N	N	N	N										
I	4	Removing old finishes in preparation for resurfacing.	N	N	N	N	N	N	N	N	N	N	N	N										
I	5	Preparing stain and applicator for use on the interior and exterior of a house.	N	N	N	N	N	N	N	N	N	N	N	N										
II	6	Preparing paint and applicator for use in painting a house.	N	N	N	N	N	N	N	N	N	N	N	N										
I	7	Preparing clear finishes and applicators for use on the exterior and interior of a house.	N	N	N	N	N	N	N	N	N	N	N	N										
I	8	Cleaning and storing brushes and rollers following their use in applying finishing materials.	S	S	S	S	S	S	S	S	S	S	S	S										
I	9	Glazing a window in preparation for painting.	S	S	S	S	S	S	S	S	S	S	S	S										
I	10	Preparing joints and nail holes in dry wall construction to receive final finish.	N	N	N	N	N	N	N	N	N	N	N	N										
I	11	Applying finishing materials to provide protection and decoration of surfaces in or on a house.	N	N	N	N	N	N	N	N	N	N	N	N										

Figure 13, continued

PLUMBING EXPERIENCES

Level	Task No.	Task Statement	Student																					
			A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V
I	1	Digging a trench for plumbing installation in a house.	N	N	N	N	N	N	N	N	N	N	N	N										
I	2	Backfilling a trench following installation of plumbing lines for a house.	N	N	N	N	N	N	N	N	N	N	N	N										
I	3	Preparing copper tubing for installation in a plumbing system for a house.	U	S	S	S	S	S	S	S	S	S	S	S										
I	4	Preparing pipe for installation in a plumbing or gas supply system in a house.	S	S	S	S	S	U	S	S	S	S	S	S										
I	5	Preparing cast iron soil pipe to pour a lead joint for a waste line in a house.	U	S	S	S	S	U	S	S	S	S	S	S										
I	6	Preparing lead for pouring soil pipe joints for a house.	U	S	U	U	S	S	S	U	S	S	U	S										
I	7	Laying a drainage field with clay pipe for a house.	N	N	N	N	N	N	N	N	N	N	N	N										
I	8	Attaching mounting brackets for plumbing fixtures to frame construction.	N	N	N	N	N	N	N	N	N	N	N	N										
I	9	Attaching mounting brackets for plumbing fixtures to masonry construction.	N	N	N	N	N	N	N	N	N	N	N	N										
I	10	Installing a water closet seat in a house.	N	N	N	N	N	N	N	N	N	N	N	N										
I	11	Insulating heating and water lines in a house.	S	S	S	S	S	S	S	S	S	S	S	S										
I	12	Assembling a furnace for a house.	N	N	N	N	N	N	N	N	N	N	N	N										
I	13	Installing duct work for warm air heating system in a house.	N	N	N	N	N	N	N	N	N	N	N	N										
II	14	Installing plastic pipe for plumbing lines for a house.	S	S	S	S	S	U	S	S	S	S	S	S										
II	15	Soldering sheet metal and copper tubing to be used in a house.	S	S	S	S	S	S	S	S	S	S	U	S										
II	16	Repairing leaks in faucets in a house.	N	N	N	N	N	N	N	N	N	N	N	N										
II	17	Repairing leaks in a water closet in a house.	N	N	N	N	N	N	N	N	N	N	N	N										
II	18	Cleaning waste lines with a snake in a house.	S	U	S	S	S	S	S	U	S	U	U	S										
I	19	Welding angle iron for pipe hangers.	N	N	N	N	N	N	N	N	N	N	N	N										

Figure 13, continued

SUMMARY-EVALUATION OF CLUSTER CONCEPT PILOT PROGRAM

SCHOOL C

	1	2	3	4	5
ADMINISTRATION	The school and county administrative personnel provided minimal moral and material support to the program and the teacher.		The school and county administrative personnel actively supported the program by furnishing the teacher with moral support but with less than satisfactory material support.		The school and county administrative personnel actively supported the program by furnishing the teacher with adequate moral and material support.
TEACHER	Little academic preparation in major field. Little or no teaching experience or practical experience in major field. Seldom shows resourcefulness or initiative.		Adequate academic preparation in major field. Has some teaching experience and some practical experience in major field. Sometime shows resourcefulness and initiative.		Superior academic preparation in major field. An experienced teacher with practical experience in major field. Resourceful. An initiator.
PHYSICAL FACILITIES	The size of the laboratory is inadequate and severely restricts occupational activities. The program also suffers from lack of equipment.		The size of the laboratory is adequate but somewhat restricts occupational activities. The laboratory has the minimum amount of equipment for operating the cluster program.		Size of the laboratory allows unrestricted occupational activities. The laboratory is suitably equipped for the cluster program.
INSTRUCTION	Tasks were taught in only one or two occupations. A very restricted number of Level I tasks were performed by the students. Few experiences offered were appropriate to the cluster.		Tasks were taught in several occupations. A majority of Level I tasks were performed by the students. Experiences were not always appropriate to occupations in the cluster.		Tasks were taught in all occupations. Most Level I tasks were performed by the students. Student experiences were extremely appropriate to occupations in the cluster.
COMMUNITY INVOLVEMENT	Community organizations were unaware of, or did not support the cluster program. Little opportunity for employment was evident in the community.		Community organizations furnished some support to the cluster program. Some members of the class found employment opportunity in the community.		Community organizations cooperated by furnishing aid to the program. A large proportion of the class found employment opportunity in the community.

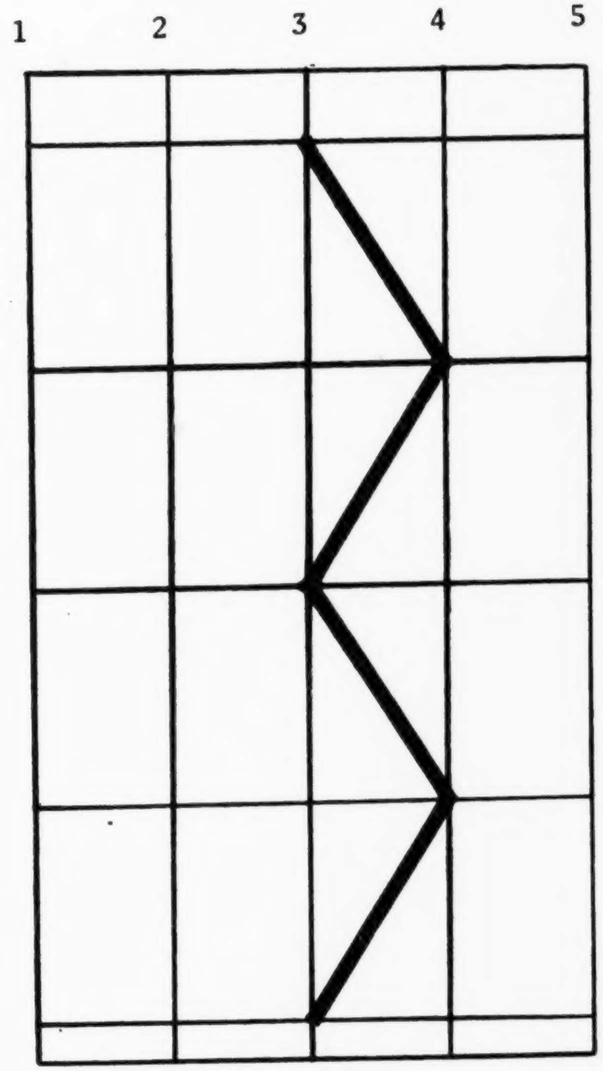


Figure 14.

Orientation. School D was a comprehensive high school composed of grades 10 through 12, located in an urban community. The school program consisted of college entrance, business, general, and vocational curriculum. Students entering grade 10 selected one of these programs to be followed for the remainder of their high school career.

In addition to the areas of home economics and business, the other vocational programs in School D included automotives, painting and interior decorating, carpentry, metalworking, masonry, graphic arts, and cosmetology. School D also had several industrial arts courses.

The introduction of the construction cluster into this school allowed those students enrolled in the general program to elect a course which would provide them with technical skills, while not tracking them into the vocational program.

The administration. The school administration favored the cluster concept program and aided Teacher D with problems involving enrollment and class time.

The administration provided Teacher D with the major pieces of equipment and materials needed to conduct his program. However, many of the major pieces of equipment obtained were not connected to electrical lines prior to the end of the school year. The supervisor of industrial education met with members of the research team and with the principal investigator several times throughout the year to discuss the cluster concept programs in his county.

The teacher. Teacher D's education consisted of a B.S. degree in Trade Education, plus six graduate credits in vocational education. Teacher D had seventeen years teaching experience at the senior high school level. He also had experience in teaching adult education courses, and had several years experience in the construction field both full- and part-time as a bricklayer. During World War II he had served on the cadre at a basic training center.

Physical facilities. Sixteen boys were enrolled in the construction cluster in School D. The class met in the laboratory used for instruction in vocational masonry. While the facility was large enough to accommodate the class, it did not contain enough of the equipment and work space needed in order to instruct the students in the four other areas of the construciton cluster.

Because of the physical limitations of the laboratory, Teacher D utilized the other vocational laboratories in the school such as the carpentry laboratory and the facilities used for painting and interior decorating.

A detailed drawing of the laboratory in which the construction cluster was conducted is shown at the end of this section. This drawing also indicates major pieces of equipment and shows their location in the laboratory. See Illustration 3.

At the start of the 1967-1968 school year, Teacher D had 50 percent of the tools and equipment recommended by the cluster concept research team as necessary to conduct an efficient program. During the course of the 1967-1968 school year, approximately 25 percent more of the recommended materials and equipment were obtained.

Instruction. The first several weeks of school were spent orienting the students to the program, developing basic tool skills, and performing exercises in various areas of the construction cluster.

Group projects within this cluster included the construction of a darkroom in the graphic arts laboratory of the high school. The walls were constructed of cinderblock, the doorway was framed and doors were hung. In addition to other tasks in the masonry areas, the class produced cement park benches using production line techniques whenever possible.

The construction cluster class also utilized other vocational laboratories within the school and performed various tasks in the areas of carpentry, electricity, masonry, painting, and plumbing.. The tasks in these areas were accomplished by constructing a corner section of a building and performing the various tasks in this structure.

In order to evaluate the performance of each student enrolled in the construction cluster a task inventory was developed. This inventory listed all the tasks to be taught in the construction cluster as developed in phase I of the cluster concept project. When kept up-to-date, it represented a record of student progress and achievement to teachers, parents, pupils, and in some instances, employers.

The task evaluation charts located at the end of this section are of two types. One list indicates the tasks which were to be taught in the cluster concept program. Those tasks taught this year are indicated by a check (✓). Those tasks taught this year which the teacher feels need to be retaught next year are indicated by a double check mark (✓✓). See Figure 15.

The second evaluation chart indicated, in the teacher's opinion, how each student in his class performed the task. Each student received either a satisfactory (S) or unsatisfactory (U) as an evaluation of his achievement. Those tasks not taught during the first year of pilot programs were indicated by the letter (N). See Figure 16.

Community involvement. Community involvement in the construction cluster at School D included field trips and tours of local construction sites, one to a local labor union and the other to the construction site of a food store. Several of the class members were able to obtain employment within the community in one of the occupations of the cluster.

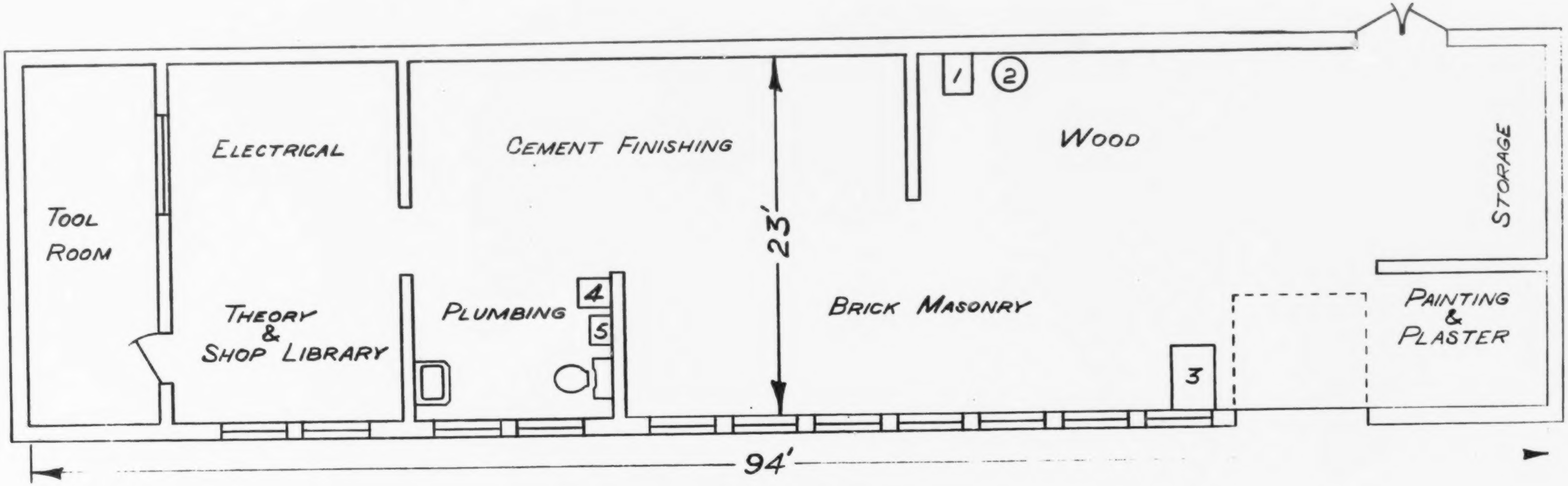
A visual summary of the preceding five areas, administration, teacher, physical facilities, instruction, and community involvement, which have been featured in the description of the construction cluster pilot program at School D, is presented in Figure 17.

Summary and recommendation. A major portion of the activities in this school were concerned with the masonry area. This in part was due to the physical arrangement of the laboratory. This laboratory was and still is being utilized for instruction in the area of masonry. Equipment for instruction in the other area, while available in the school, is not included in this laboratory, and when received, remained inoperative because they were not yet wired for use.

The program would have been greatly improved provided that additional equipment needed for the program was available and operable at the start of the school year.

SCHOOL D

CONSTRUCTION CLUSTER


TOOL ROOM
ELECTRICAL
THEORY & SHOP LIBRARY
CEMENT FINISHING
PLUMBING
4
5
23'
WOOD
1
2
BRICK MASONRY
3
STORAGE
PAINTING & PLASTER
94'

1. DRILL PRESS
2. VACUUM CLEANER
3. CEMENT MIXER
4. PIPE CUTTING, THREADING AND REAMING MACHINE
5. WATER PUMP

ILLUSTRATICN 3

CARPENTRY EXPERIENCES

Level	Task No.	Task Statement	
I	1	Mixing mortar for mudsills of a house.	✓
I	2	Constructing a saw horse and a trestle for use on construction site.	✓
II	3	Cutting building material to length for a house.	✓
I	4	Erecting girders and columns for a house.	✓✓
II	5	Framing a box sill for a house.	✓✓
I	6	Installing hangers and anchors for floor joists for a house.	✓✓
II	7	Erecting floor and ceiling framing joists for a house.	✓✓
I	8	Installing cross bridging between floor joists for a house.	✓✓
I	9	Installing solid bridging between floor joists for a house.	✓✓
I	10	Laying subfloors on floor joists for a house.	✓✓
II	11	Framing bathroom floors for a tile floor in a house.	✓✓
II	12	Building up corner posts for corner of framing in a house.	✓✓
II	13	Laying out stud spacing for walls and partition.	✓✓
II	14	Assembling walls and partitions for a frame house.	✓✓
II	15	Erecting wall sections for a house.	✓✓
I	16	Applying lap, plywood or composition sheathing for a house.	✓✓
I	17	Installing fire stops along plate in a house.	✓✓
II	18	Installing staging brackets for house construction.	✓✓
II	19	Installing single and double post scaffolding for house construction.	✓✓
II	20	Framing a flat roof for a house.	✓✓
II	21	Installing gable studs for a house.	✓✓
I	22	Laying roof decking for a house.	✓✓
I	23	Applying building paper to sidewall, rough floor or roof deck on a house.	
I	24	Building a foot rest for shingling a roof on a house.	
II	25	Installing metal drip edge on roof for a house.	
I	26	Applying roll roofing for a house.	
II	27	Applying sheet metal roofing to a house.	
II	28	Applying built-up roofing to a house.	
II	29	Installing a hanging gutter to a house roof.	✓✓
II	30	Fastening wood to masonry with fasteners in a house.	✓✓
I	31	Installing blanket, bulk, batt, rigid and metallic insulation in a house.	✓✓
I	32	Installing backing to an interior wall of a house.	✓✓
I	33	Applying commercial wall board to the interior of a house.	✓✓
II	34	Installing furring and grounds to interior of a house.	✓✓
I	35	Applying lath to house studding.	✓✓
II	36	Applying corner boards on a house.	✓✓
II	37	Assembling basement stairs for a house.	✓✓
II	38	Erecting roof and deck framing for a house porch.	
II	39	Laying porch floors for a house.	✓✓

ELECTRICITY EXPERIENCES

Level	Task No.	Task Statement	
I	1	Installing boxes for receptacles, switches, junctions and fixtures in a house.	
I	2	Installing wiring from box to box in a house.	
I	3	Connecting receptacles, single throw switches, fixtures and pilot lights to complete circuits in a house.	
II	4	Erecting a temporary service pole for portable electric equipment used in building	✓✓

Figure 15.

Level	Task No.	Task Statement	
I	5	Installing rigid, thin wall and flexible conduit in a house.	
II	6	Installing a separate circuit for an electric range in a house.	
II	7	Installing grounds for a house wiring system.	✓✓
II	8	Installing entrance cable on the exterior of a house.	✓✓
II	9	Installing low voltage operated bells and signalling devices in a house.	
II	10	Connecting a hot water heater to a power source in a house.	
II	11	Connecting a water pump to a power source in a house.	
II	12	Installing an attic fan or room cooler in a house.	✓✓
		MASONRY EXPERIENCES	
I	1	Setting up a work area in order to expedite the mixing of concrete on the job.	✓
I	2	Cleaning and oiling concrete forms prior to and afer their use on a building.	✓
II	3	Preparing a batch of cement, plaster, lime mortar and cement-lime mortar by hand and by machine at the construction site.	✓
I	4	Shoring sidewalls of earthen ditches to prevent cave-ins during excavation.	✓✓
II	5	Installing rods and spreaders to space form section before pouring cement.	✓✓
I	6	Wiring and bolting forms to prevent spreading during pouring.	✓✓
II	7	Bracing sidewalls of forms to prevent spreading during pouring.	✓✓
I	8	Installing anchor bolts in masonry walls and concrete to provide a place for securing future construction.	✓
I	9	Protecting a concrete slab following finishing operations to provide for proper curing.	✓
I	10	Erecting scaffolding for use by a mason at the building site.	✓
I	11	Cleaning out mortar joints for tuck pointing on a masonry wall.	✓
I	12	Pointing up a section of a brick wall to provide a finished appearance on a house.	✓✓
I	13	Applying colorless coating to waterproof masonry surfaces above grade on a building.	✓✓
I	14	Applying asphalt coating to waterproof foundation wall below grade on a building.	✓✓
I	15	Pouring a section of footing containing reinforcing rods for a house.	✓
I	16	Pouring a small reinforced concrete slab suitable for a porch deck on a house.	✓
II	17	Installing footer forms to receive concrete for a foundation.	✓
II	18	Setting a section of sidewalk form to receive concrete at a building site.	✓
II	19	Finishing a small concrete slab to provide utility and pleasing appearance.	✓
II	20	Laying cement block for a wall in stretcher courses for a building.	✓
		PAINTING EXPERIENCES	
I	1	Preparing a surface for application of stain on the interior or exterior of a house.	✓✓
I	2	Preparing a surface for application of paint on the interior or exterior of a house.	✓✓
II	3	Preparing a surface for application of a clear finish on the interior or exterior of a house.	✓✓
I	4	Removing old finishes in preparation for resurfacing.	✓✓
I	5	Preparing stain and applicator for use on the interior and exterior of a house.	✓✓
II	6	Preparing paint and applicator for use in painting a house.	✓✓
I	7	Preparing clear finishes and applicators for use on the exterior and interior of a house.	✓✓
I	8	Cleaning and storing brushes and rollers following their use in applying finishing materials.	✓✓
I	9	Glazing a window in preparation for painting.	
I	10	Preparing joints and nail holes in dry wall construction to receive final finish.	✓✓
I	11	Applying finishing materials to provide protection and decoration of surfaces in or on a house.	✓✓

Figure 15, continued

PLUMBING EXPERIENCES

Level	Task No.	Task Statement	
I	1	Digging a trench for plumbing installation in a house.	✓
I	2	Backfilling a trench following installation of plumbing lines for a house.	✓
I	3	Preparing copper tubing for installation in a plumbing system for a house.	☐
I	4	Preparing pipe for installation in a plumbing or gas supply system in a house.	☐
I	5	Preparing cast iron soil pipe to pour a lead joint for a waste line in a house.	☐
I	6	Preparing lead for pouring soil pipe joints for a house.	☐
I	7	Laying a drainage field with clay pipe for a house.	☐
I	8	Attaching mounting brackets for plumbing fixtures to frame construction.	☐
I	9	Attaching mounting brackets for plumbing fixtures to masonry construction.	☐
I	10	Installing a water closet seat in a house.	✓✓
I	11	Insulating heating and water lines in a house.	☐
I	12	Assembling a furnace for a house.	☐
I	13	Installing duct work for warm air heating system in a house.	☐
II	14	Installing plastic pipe for plumbing lines for a house.	☐
II	15	Soldering sheet metal and copper tubing to be used in a house.	☐
II	16	Repairing leaks in faucets in a house.	✓✓
II	17	Repairing leaks in a water closet in a house.	✓✓
II	18	Cleaning waste lines with a snake in a house.	☐
I	19	Welding angle iron for pipe hangers.	☐

Figure 15, continued

CARPENTRY EXPERIENCES

Level	Task No.	Task Statement	Student																					
			A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V
I	1	Mixing mortar for mudsills of a house.	S	S	S	S	S	S	S	S	S													
I	2	Constructing a saw horse and a trestle for use on construction site.	S	S	S	S	S	S	S	S	S													
II	3	Cutting building material to length for a house.	S	S	S	S	S	U	S	S	S													
I	4	Erecting girders and columns for a house.	S	S	S	U	S	S	S	S	S													
II	5	Framing a box sill for a house.	S	S	S	U	S	U	S	S	S													
I	6	Installing hangers and anchors for floor joists for a house.	S	S	S	U	S	U	S	S	S													
II	7	Erecting floor and ceiling framing joists for a house.	S	S	S	U	S	U	S	S	S													
I	8	Installing cross bridging between floor joists for a house.	S	S	S	U	S	U	S	S	S													
I	9	Installing solid bridging between floor joists for a house.	U	U	U	U	S	U	S	S	S													
I	10	Laying subfloors on floor joists for a house.	U	U	U	U	S	S	S	S	S													
II	11	Framing bathroom floors for a tile floor in a house.	U	U	U	U	S	S	U	U	S													
II	12	Building up corner posts for corner of framing in a house.	U	U	U	S	U	U	U	U	U													
II	13	Laying out stud spacing for walls and partition.	S	S	S	S	U	U	U	U	U													
II	14	Assembling walls and partitions for a frame house.	S	S	S	U	U	U	U	U	S													
II	15	Erecting wall sections for a house.	U	U	U	U	U	U	U	U	S													
I	16	Applying lap, plywood or composition sheathing for a house.	U	U	U	U	U	S	U	U	S													
I	17	Installing fire stops along plate in a house.	U	U	U	U	U	U	U	U	S													
II	18	Installing staging brackets for house construction.	U	U	U	U	S	U	S	U	S													
II	19	Installing single and double post scaffolding for house construction.	S	S	S	U	S	S	S	U	U													
II	20	Framing a flat roof for a house.	S	S	S	U	S	U	U	U	S													

Figure 16.

			Student																					
Level	Task No.	Task Statement	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V
II	21	Installing gable studs for a house.	U	U	U	U	U	U	S	U	U													
I	22	Laying roof decking for a house.	S	S	S	U	S	S	U	U	S													
I	23	Applying building paper to sidewall, rough floor or roof deck on a house.	N	N	N	N	N	N	N	N	N													
I	24	Building a foot rest for shingling a roof on a house.	N	N	N	N	N	N	N	N	N													
II	25	Installing metal drip edge on roof for a house.	N	N	N	N	N	N	N	N	N													
I	26	Applying roll roofing for a house.	N	N	N	N	N	N	N	N	N													
II	27	Applying sheet metal roofing to a house.	N	N	N	N	N	N	N	N	N													
II	28	Applying built-up roofing to a house.	N	N	N	N	N	N	N	N	N													
II	29	Installing a hanging gutter to a house roof.	S	U	S	S	S	U	S	U	U													
II	30	Fastening wood to masonry with fasteners in a house.	S	U	S	S	S	U	S	S	U													
I	31	Installing blanket, bulk, batt, rigid and metallic insulation in a house.	U	U	U	U	U	U	S	U	U													
I	32	Installing backing to an interior wall of a house.	S	S	S	U	S	U	U	U	S													
I	33	Applying commercial wall board to the interior of a house.	S	S	S	U	S	U	U	U	S													
II	34	Installing furring and grounds to interior of a house.	S	U	S	S	S	U	U	S	S													
I	35	Applying lath to house studding.	S	U	S	S	S	U	U	U	U													
II	36	Applying corner boards on a house.	S	U	S	U	S	U	U	U	U													
II	37	Assembling basement stairs for a house.	U	U	S	U	S	U	U	U	U													
II	38	Erecting roof and deck framing for a house porch.	N	N	N	N	N	N	N	N	N													
II	39	Laying porch floors for a house.	U	U	U	U	S	S	U	U	U													
		ELECTRICITY EXPERIENCES																						
I	1	Installing boxes for receptacles, switches, junctions and fixtures in a house.	N	N	N	N	N	N	N	N	N													
I	2	Installing wiring from box to box in a house.	N	N	N	N	N	N	N	N	N													
I	3	Connecting receptacles, single throw switches, fixtures and pilot lights to complete circuits in a house.	N	N	N	N	N	N	N	N	N													
II	4	Erecting a temporary service pole for portable electric equipment used in building	S	S	S	U	S	U	S	U	U													

Figure 16, continued

			Student																					
Level	Task No.	Task Statement	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V
I	5	Installing rigid, thin wall and flexible conduit in a house.	N	N	N	N	N	N	N	N	N													
II	6	Installing a separate circuit for an electric range in a house.	N	N	N	N	N	N	N	N	N													
II	7	Installing grounds for a house wiring system.	S	S	S	U	S	U	S	U	S													
II	8	Installing entrance cable on the exterior of a house.	S	U	S	U	S	U	N	U	U													
II	9	Installing low voltage operated bells and signalling devices in a house.	N	N	N	N	N	N	N	N	N													
II	10	Connecting a hot water heater to a power source in a house.	N	N	N	N	N	N	N	N	N													
II	11	Connecting a water pump to a power source in a house.	N	N	N	N	N	N	N	N	N													
II	12	Installing an attic fan or room cooler in a house.	S	S	S	U	S	U	U	S	U													
		MASONRY EXPERIENCES																						
I	1	Setting up a work area in order to expedite the mixing of concrete on the job.	S	S	S	S	S	S	S	S	S													
I	2	Cleaning and oiling concrete forms prior to and after their use on a building.	S	S	S	S	S	S	S	S	S													
II	3	Preparing a batch of cement, plaster, lime mortar and cement-lime mortar by hand and by machine at the construction site.	S	S	S	S	S	S	S	S	S													
I	4	Shoring sidewalls of earthen ditches to prevent cave-ins during excavation.	S	S	S	U	S	U	S	S	S													
II	5	Installing rods and spreaders to space form section before pouring cement.	S	S	S	U	S	U	S	S	S													
I	6	Wiring and bolting forms to prevent spreading during pouring.	S	S	S	U	S	U	S	S	S													
II	7	Bracing sidewalls of forms to prevent spreading during pouring.	S	S	S	S	S	U	S	S	S													
I	8	Installing anchor bolts in masonry walls and concrete to provide a place for securing future construction.	S	S	S	S	S	S	S	S	S													
I	9	Protecting a concrete slab following finishing operations to provide for proper curing.	S	S	S	U	S	S	S	S	U													
I	10	Erecting scaffolding for use by a mason at the building site.	S	S	S	U	S	S	S	S	U													
I	11	Cleaning out mortar joints for tuck pointing on a masonry wall.	S	S	S	U	S	S	S	S	U													

Figure 16, continued

Level	Task No.	Task Statement	Student A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V
I	12	Pointing up a section of a brick wall to provide a finished appearance on a house.	S	S	S	U	S	U	S	U	U													
I	13	Applying colorless coating to waterproof masonry surfaces above grade on a building.	S	S	S	U	S	U	S	U	U													
I	14	Applying asphalt coating to waterproof foundation wall below grade on a building.	S	S	S	S	S	U	S	U	U													
I	15	Pouring a section of footing containing reinforcing rods for a house.	S	S	S	S	S	U	S	S	U													
I	16	Pouring a small reinforced concrete slab suitable for a porch deck on a house.	S	S	S	S	S	U	S	U	U													
II	17	Installing footer forms to receive concrete for a foundation.	S	S	S	U	S	U	S	S	U													
II	18	Setting a section of sidewalk form to receive concrete at a building site.	S	S	S	U	S	U	S	S	U													
II	19	Finishing a small concrete slab to provide utility and pleasing appearance.	S	S	S	U	S	U	S	U	U													
II	20	Laying cement block for a wall in stretcher courses for a building.	S	S	S	S	S	S	S	U	U													
		PAINTING EXPERIENCES																						
I	1	Preparing a surface for application of stain on the interior or exterior of a house.	S	S	S	U	S	S	U	U	U													
I	2	Preparing a surface for application of paint on the interior or exterior of a house.	S	S	S	U	S	S	U	U	U													
II	3	Preparing a surface for application of a clear finish on the interior or exterior of a house.	S	S	S	S	S	S	U	S	U													
I	4	Removing old finishes in preparation for resurfacing.	S	S	S	S	S	U	U	U	U													
I	5	Preparing stain and applicator for use on the interior and exterior of a house.	S	S	S	S	S	U	U	U	U													
II	6	Preparing paint and applicator for use in painting a house.	S	S	S	U	S	U	U	U	U													
I	7	Preparing clear finishes and applicators for use on the exterior and interior of a house.	S	S	S	U	S	U	U	U	U													
I	8	Cleaning and storing brushes and rollers following their use in applying finishing materials.	S	S	S	U	S	U	U	S	U													
I	9	Glazing a window in preparation for painting.	N	N	N	N	N	N	N	N	N													
I	10	Preparing joints and nail holes in dry wall construction to receive final finish.	S	S	S	U	S	S	U	U	U													
I	11	Applying finishing materials to provide protection and decoration of surfaces in or on a house.	S	S	S	U	S	U	U	U	U													

Figure 16, continued

PLUMBING EXPERIENCES

Level	Task No.	Task Statement	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V
I	1	Digging a trench for plumbing installation in a house.	S	S	S	S	S	S	U	S	U													
I	2	Backfilling a trench following installation of plumbing lines for a house.	S	S	S	S	S	S	U	S	U													
I	3	Preparing copper tubing for installation in a plumbing system for a house.	N	N	N	N	N	N	N	N	N													
I	4	Preparing pipe for installation in a plumbing or gas supply system in a house.	N	N	N	N	N	N	N	N	N													
I	5	Preparing cast iron soil pipe to pour a lead joint for a waste line in a house.	N	N	N	N	N	N	N	N	N													
I	6	Preparing lead for pouring soil pipe joints for a house.	N	N	N	N	N	N	N	N	N													
I	7	Laying a drainage field with clay pipe for a house.	N	N	N	N	N	N	N	N	N													
I	8	Attaching mounting brackets for plumbing fixtures to frame construction.	N	N	N	N	N	N	N	N	N													
I	9	Attaching mounting brackets for plumbing fixtures to masonry construction.	N	N	N	N	N	N	N	N	N													
I	10	Installing a water closet seat in a house.	U	S	U	S	S	U	U	U	U													
I	11	Insulating heating and water lines in a house.	N	N	N	N	N	N	N	N	N													
I	12	Assembling a furnace for a house.	N	N	N	N	N	N	N	N	N													
I	13	Installing duct work for warm air heating system in a house.	N	N	N	N	N	N	N	N	N													
II	14	Installing plastic pipe for plumbing lines for a house.	N	N	N	N	N	N	N	N	N													
II	15	Soldering sheet metal and copper tubing to be used in a house.	N	N	N	N	N	N	N	N	N													
II	16	Repairing leaks in faucets in a house.	S	S	S	S	S	U	U	U	U													
II	17	Repairing leaks in a water closet in a house.	S	U	S	S	S	U	S	U	U													
II	18	Cleaning waste lines with a snake in a house.	N	N	N	N	N	N	N	N	N													
II	19	Welding angle iron for pipe hangers.	N	N	N	N	N	N	N	N	N													

Figure 16, continued

SUMMARY-EVALUATION OF CLUSTER CONCEPT PILOT PROGRAM
SCHOOL D - TEACHER D

	1	2	3	4	5
ADMINISTRATION	The school and county administrative personnel provided minimal moral and material support to the program and the teacher.		The school and county administrative personnel actively supported the program by furnishing the teacher with moral support but with less than satisfactory material support.		The school and county administrative personnel actively supported the program by furnishing the teacher with adequate moral and material support.
TEACHER	Little academic preparation in major field. Little or no teaching experience or practical experience in major field. Seldom shows resourcefulness or initiative.		Adequate academic preparation in major field. Has some teaching experience and some practical experience in major field. Sometime shows resourcefulness and initiative.		Superior academic preparation in major field. An experienced teacher with practical experience in major field. Resourceful. An initiator.
PHYSICAL FACILITIES	The size of the laboratory is inadequate and severely restricts occupational activities. The program also suffers from lack of equipment.		The size of the laboratory is adequate but somewhat restricts occupational activities. The laboratory has the minimum amount of equipment for operating the cluster program.		Size of the laboratory allows unrestricted occupational activities. The laboratory is suitably equipped for the cluster program.
INSTRUCTION	Tasks were taught in only one or two occupations. A very restricted number of Level I tasks were performed by the students. Few experiences offered were appropriate to the cluster.		Tasks were taught in several occupations. A majority of Level I tasks were performed by the students. Experiences were not always appropriate to occupations in the cluster.		Tasks were taught in all occupations. Most Level I tasks were performed by the students. Student experiences were extremely appropriate to occupations in the cluster.
COMMUNITY INVOLVEMENT	Community organizations were unaware of, or did not support the cluster program. Little opportunity for employment was evident in the community.		Community organizations furnished some support to the cluster program. Some members of the class found employment opportunity in the community.		Community organizations cooperated by furnishing aid to the program. A large proportion of the class found employment opportunity in the community.

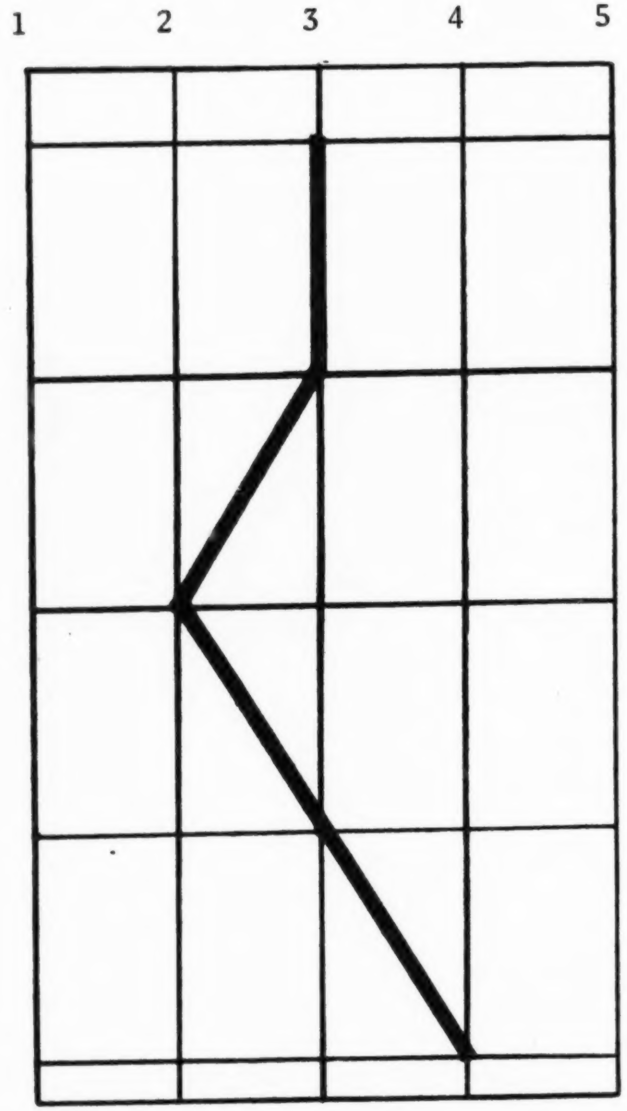


Figure 17.

Orientation. School H was located in a rural community and was composed of grades 7 through 12. The school program consisted of basic general education for grades 7 and 8. Students entering grade 9 selected a program to be followed for the remainder of their high school career. The students selected either the college entrance, business, or general curriculum.

The introduction of the construction cluster into this school added another dimension to the practical arts curriculum. In addition to the construction cluster,the other practical areas of the curriculum included courses in vocational agriculture, business, home economics, and industrial arts.

The administration. The principal of School H supported the cluster concept program and gave his full cooperation to Teacher H in his execution of the program.

The county administration, while favoring the program, provided Teacher H with little additional equipment or supplies to conduct his class. In discussing the lack of material and supplies with county officials and Teacher H, members of the research team were unable to determine the source of the problem. Either the county had not processed the requisitions submitted, or Teacher H never submitted requisitions for additional equipment, material, or supplies.

The teacher. Teacher H held a B.S. degree in Physical Education with a minor in Social Studies. He also had a M.A. degree in School Administration with a minor in Geography. Teacher H had six years teaching experience in industrial arts and four years industrial experience in home construction.

Physical facilities. Sixteen boys were enrolled in the construction cluster in School H. The class met in the industrial arts laboratory and utilized the equipment in this facility. Whenever the weather allowed, members of the construction cluster also utilized a paved area adjacent to the laboratory for the construction of tool sheds and other projects of this type.

At the start of the 1967-1968 school year, approximately fifteen percent of the equipment and materials recommended by the cluster concept project research team as necessary to conduct an effective program had been received. During the course of the school year, approximately ten percent of the recommended materials were received.

Teacher H conducted his program by utilizing the material and equipment allocated for his regular industrial arts program. Teacher H also obtained orders from private individuals for the construction of tool or garden sheds. These items were constructed by members of the construction cluster and sold for the cost of the materials in order to secure additional materials needed for the cluster concept program.

A detailed drawing of the laboratory in which the construction cluster was conducted is shown at the end of this section. The drawing also indicates the major pieces of equipment and shows their location in the laboratory. See Illustration 4.

Instruction. The first several weeks of school were spent orienting the students to the program, developing basic tool skills and planning, and designing a Swiss-style garden shed which was the first project constructed by the group.

Carpentry and painting were the only areas of the construction cluster taught in School H. These experiences were obtained through the construction and painting of the following items or projects: saw horses; 1-6' x 10' Swiss-style tool shed; 1-8' x 10' Swiss-type garden shed; 1-6' x 10' garden shed; 2-6' x 10' storage sheds; 1-8' x 10' tool shed. All of these structures were trimmed and painted. Some of these structures utilized the pre-fabricated techniques of construction with final assembly taking place at the permanent location.

An additional activity in the area of carpentry included the erection of partitions in a small barn on school grounds. The facility was then used to store lumber for the construction cluster and projects of industrial art students.

The final project of the year was the construction of a 12' x 12' storage building erected on school grounds. This building was to house track and other athletic equipment.

In order to evaluate the performance of each student enrolled in the construction cluster, a task inventory was developed. This inventory listed all the tasks to be taught in the construction cluster as developed in phase I of the cluster concept project. When kept up-to-date, it represented a record of student progress and achievement to teachers, parents, pupils, and in some instances, employers.

The task evaluation charts located at the end of this section are of two types. One list indicates the tasks which were to be taught in the cluster concept program. Those tasks taught this year are indicated by a check (✓). Those tasks taught this year which the teacher feels need to be retaught next year are indicated by a double check mark (✓✓). See Figure 18.

The second evaluation chart indicated, in the teacher's opinion, how each student in his class performed the task. Each student received either a satisfactory (S) or unsatisfactory (U) as an evaluation of his achievement. Those tasks not taught during the first year of pilot programs were indicated by the letter (N). See Figure 19.

Community involvement. Community involvement in the construction cluster at School H was obtained through Teacher H's ability to contract jobs for his students. Several tool and garden sheds were built by students in the construction cluster and erected at sites on private property. This provided the boys with practical experience and also allowed them to use their skills to construct a useful item.

Approximately one-half of the construction cluster class was able to obtain summer employment in one of the occupations in the cluster. Field trips to building supply dealers and to the construction site of a housing development were also taken by members of the construction cluster.

A visual summary of the preceding five areas, administration, teacher, physical facilities, instruction, and community involvement, which have been featured in the description of the pilot program at School H, is presented in Figure 20.

Summary and recommendations. The students at School H were provided broad experiences in the area of carpentry, painting, with no experience in the other areas of construction.

The program at School H could have been improved had Teacher H received materials needed for instruction in the other areas of construction.

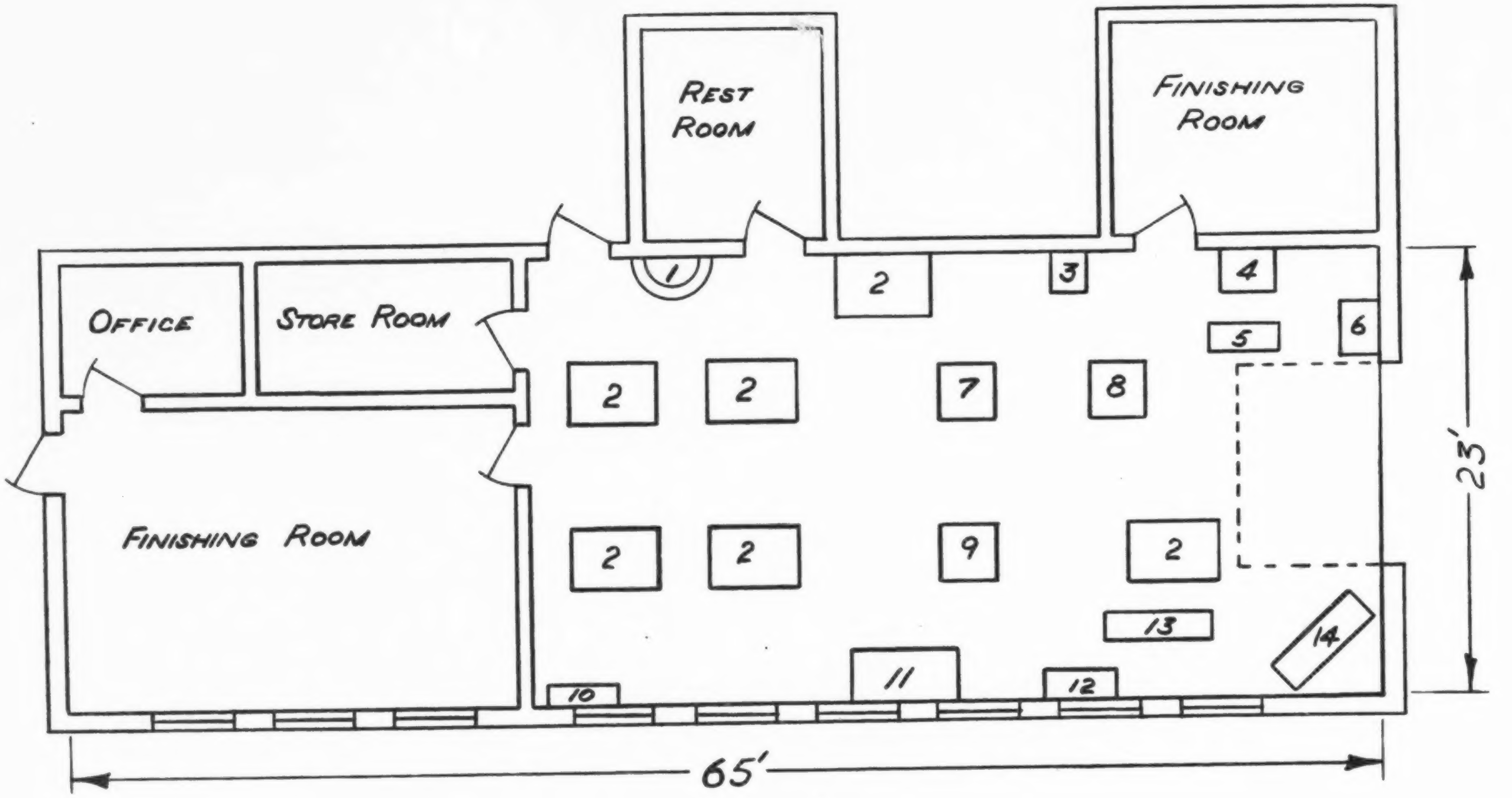
The construction of buildings for sale, while providing excellent experience for students, should not provide financial support for the construction cluster in School H, nor should they be allowed to constitute the only experiences provided to the students in the area of construction.

Additional county funds should be provided to support the cluster program. Also, a large facility in which corner sections could be constructed and used for activities in the areas of plumbing and electricity would greatly improve the situation at School H. By eliminating the construction of buildings and utilizing the paved work area adjacent to the laboratory, Teacher H could provide working space and instruction in the masonry area. Students could use this space for laying cement block and performing other types of masonry work.

The pictures at the end of this section represent typical activities engaged in by students enrolled in the construction cluster.

SCHOOL H

CONSTRUCTION CLUSTER


REST ROOM
FINISHING ROOM
OFFICE
STORE ROOM
FINISHING ROOM
1
2
3
4
5
6
7
8
9
10
11
12
13
14
23'
65'

1. SINK
2. WORK BENCH
3. DRILL PRESS
4. MORTISING MACHINE
5. BAND SAW
6. SANDER
7. TABLE SAW
8. SHAPER
9. PLANER
10. TOOL CABINET
11. RADIAL ARM SAW
12. MITER SAW
13. JOINTER
14. WOOD LATHE

ILLUSTRATION 4

CARPENTRY EXPERIENCES

Level	Task No.	Task Statement	
I	1	Mixing mortar for mudsills of a house.	✓✓
I	2	Constructing a saw horse and a trestle for use on construction site.	✓
II	3	Cutting building material to length for a house.	✓
I	4	Erecting girders and columns for a house.	✓✓
II	5	Framing a box sill for a house.	✓✓
I	6	Installing hangers and anchors for floor joists for a house.	✓✓
II	7	Erecting floor and ceiling framing joists for a house.	✓
I	8	Installing cross bridging between floor joists for a house.	✓
I	9	Installing solid bridging between floor joists for a house.	✓
I	10	Laying subfloors on floor joists for a house.	✓
II	11	Framing bathroom floors for a tile floor in a house.	✓
II	12	Building up corner posts for corner of framing in a house.	✓✓
II	13	Laying out stud spacing for walls and partition.	✓
II	14	Assembling walls and partitions for a frame house.	✓
II	15	Erecting wall sections for a house.	✓
I	16	Applying lap, plywood or composition sheathing for a house.	✓
I	17	Installing fire stops along plate in a house.	✓
II	18	Installing staging brackets for house construction.	✓
II	19	Installing single and double post scaffolding for house construction.	✓
II	20	Framing a flat roof for a house.	✓
II	21	Installing gable studs for a house.	✓✓
I	22	Laying roof decking for a house.	✓
I	23	Applying building paper to sidewall, rough floor or roof deck on a house.	✓
I	24	Building a foot rest for shingling a roof on a house.	✓
II	25	Installing metal drip edge on roof for a house.	✓
I	26	Applying roll roofing for a house.	✓
II	27	Applying sheet metal roofing to a house.	
II	28	Applying built-up roofing to a house.	
II	29	Installing a hanging gutter to a house roof.	
II	30	Fastening wood to masonry with fasteners in a house.	
I	31	Installing blanket, bulk, batt, rigid and metallic insulation in a house.	✓
I	32	Installing backing to an interior wall of a house.	
I	33	Applying commercial wall board to the interior of a house.	✓
II	34	Installing furring and grounds to interior of a house.	
I	35	Applying lath to house studding.	
II	36	Applying corner boards on a house.	✓✓
II	37	Assembling basement stairs for a house.	
II	38	Erecting roof and deck framing for a house porch.	
II	39	Laying porch floors for a house.	
		ELECTRICITY EXPERIENCES	
I	1	Installing boxes for receptacles, switches, junctions and fixtures in a house.	
I	2	Installing wiring from box to box in a house.	
I	3	Connecting receptacles, single throw switches, fixtures and pilot lights to complete circuits in a house.	
II	4	Erecting a temporary service pole for portable electric equipment used in building	

Figure 18.

Level	Task No.	Task Statement	
I	5	Installing rigid, thin wall and flexible conduit in a house.	☐
II	6	Installing a separate circuit for an electric range in a house.	☐
II	7	Installing grounds for a house wiring system.	☐
II	8	Installing entrance cable on the exterior of a house.	☐
II	9	Installing low voltage operated bells and signalling devices in a house.	☐
II	10	Connecting a hot water heater to a power source in a house.	☐
II	11	Connecting a water pump to a power source in a house.	☐
II	12	Installing an attic fan or room cooler in a house.	☐
		MASONRY EXPERIENCES	☐
I	1	Setting up a work area in order to expedite the mixing of concrete on the job.	☐
I	2	Cleaning and oiling concrete forms prior to and afor their use on a building.	☐
II	3	Preparing a batch of cement, plaster, lime mortar and cement-lime mortar by hand and by machine at the construction site.	☐
I	4	Shoring sidewalls of earthen ditches to prevent cave-ins during excavation.	☐
II	5	Installing rods and spreaders to space form section before pouring cement.	☐
I	6	Wiring and bolting forms to prevent spreading during pouring.	☐
II	7	Bracing sidewalls of forms to prevent spreading during pouring.	☐
I	8	Installing anchor bolts in masonry walls and concrete to provide a place for securing future construction.	☐
I	9	Protecting a concrete slab following finishing operations to provide for proper curing.	☐
I	10	Erecting scaffolding for use by a mason at the building site.	☐
I	11	Cleaning out mortar joints for tuck pointing on a masonry wall.	☐
I	12	Pointing up a section of a brick wall to provide a finished appearance on a house.	☐
I	13	Applying colorless coating to waterproof masonry surfaces above grade on a building.	☐
I	14	Applying asphalt coating to waterproof foundation wall below grade on a building.	☐
I	15	Pouring a section of footing containing reinforcing rods for a house.	☐
I	16	Pouring a small reinforced concrete slab suitable for a porch deck on a house.	☐
II	17	Installing footer forms to receive concrete for a foundation.	☐
II	18	Setting a section of sidewalk form to receive concrete at a building site.	☐
II	19	Finishing a small concrete slab to provide utility and pleasing appearance.	☐
II	20	Laying cement block for a wall in stretcher courses for a building.	☐
		PAINTING EXPERIENCES	☐
I	1	Preparing a surface for application of stain on the interior or exterior of a house.	☑
I	2	Preparing a surface for application of paint on the interior or exterior of a house.	☑
II	3	Preparing a surface for application of a clear finish on the interior or exterior of a house.	☑
I	4	Removing old finishes in preparation for resurfacing.	☑
I	5	Preparing stain and applicator for use on the interior and exterior of a house.	☑
II	6	Preparing paint and applicator for use in painting a house.	☑
I	7	Preparing clear finishes and applicators for use on the exterior and interior of a house.	☑
I	8	Cleaning and storing brushes and rollers following their use in applying finishing materials.	☑
I	9	Glazing a window in preparation for painting.	☑
I	10	Preparing joints and nail holes in dry wall construction to receive final finish.	☑
I	11	Applying finishing materials to provide protection and decoration of surfaces in or on a house.	☑

Figure 18, continued

PLUMBING EXPERIENCES

Level	Task No.	Task Statement	
I	1	Digging a trench for plumbing installation in a house.	
I	2	Backfilling a trench following installation of plumbing lines for a house.	
I	3	Preparing copper tubing for installation in a plumbing system for a house.	
I	4	Preparing pipe for installation in a plumbing or gas supply system in a house.	
I	5	Preparing cast iron soil pipe to pour a lead joint for a waste line in a house.	
I	6	Preparing lead for pouring soil pipe joints for a house.	
I	7	Laying a drainage field with clay pipe for a house.	
I	8	Attaching mounting brackets for plumbing fixtures to frame construction.	
I	9	Attaching mounting brackets for plumbing fixtures to masonry construction.	
I	10	Installing a water closet seat in a house.	
I	11	Insulating heating and water lines in a house.	
I	12	Assembling a furnace for a house.	
I	13	Installing duct work for warm air heating system in a house.	
II	14	Installing plastic pipe for plumbing lines for a house.	
II	15	Soldering sheet metal and copper tubing to be used in a house.	
II	16	Repairing leaks in faucets in a house.	
II	17	Repairing leaks in a water closet in a house.	
II	18	Cleaning waste lines with a snake in a house.	
I	19	Welding angle iron for pipe hangers.	

Figure 18, continued

CARPENTRY EXPERIENCES

			Student																			
Level	Task No.	Task Statement	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V
I	1	Mixing mortar for mudsills of a house.	U	S	S	S	S	S	S	S	S	S	S	S	S	S	U							
I	2	Constructing a saw horse and a trestle for use on construction site.	U	S	S	S	S	S	U	S	S	S	S	S	S	S	U							
II	3	Cutting building material to length for a house.	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S							
I	4	Erecting girders and columns for a house.	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S							
II	5	Framing a box sill for a house.	U	S	S	S	U	S	U	S	S	S	S	S	S	S	U							
I	6.	Installing hangers and anchors for floor joists for a house.	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S							
II	7	Erecting floor and ceiling framing joists for a house.	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S							
I	8	Installing cross bridging between floor joists for a house.	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S							
I	9	Installing solid bridging between floor joists for a house.	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S							
I	10	Laying subfloors on floor joists for a house.	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S							
II	11	Framing bathroom floors for a tile floor in a house.	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S							
II	12	Building up corner posts for corner of framing in a house.	U	S	S	S	S	S	U	S	S	S	S	S	S	S	U							
II	13	Laying out stud spacing for walls and partition.	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S							
II	14	Assembling walls and partitions for a frame house.	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S							
II	15	Erecting wall sections for a house.	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S							
I	16	Applying lap, plywood or composition sheathing for a house.	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S							
I	17	Installing fire stops along plate in a house.	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S							
II	18	Installing staging brackets for house construction.	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S							
II	19	Installing single and double post scaffolding for house construction.	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S							
II	20	Framing a flat roof for a house.	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S							

Figure 19.

Level	Task No.	Task Statement	Student																					
			A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V
II	21	Installing gable studs for a house.	U	S	S	S	S	S	U	S	S	S	U	S	S	S	U							
I	22	Laying roof decking for a house.	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S							
I	23	Applying building paper to sidewall, rough floor or roof deck on a house.	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S							
I	24	Building a foot rest for shingling a roof on a house.	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S							
II	25	Installing metal drip edge on roof for a house.	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S							
I	26	Applying roll roofing for a house.	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S							
II	27	Applying sheet metal roofing to a house.	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N							
II	28	Applying built-up roofing to a house.	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N							
II	29	Installing a hanging gutter to a house roof.	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N							
II	30	Fastening wood to masonry with fasteners in a house.	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N							
I	31	Installing blanket, bulk, batt, rigid and metallic insulation in a house.	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S							
I	32	Installing backing to an interior wall of a house.	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N							
I	33	Applying commercial wall board to the interior of a house.	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S							
II	34	Installing furring and grounds to interior of a house.	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N							
I	35	Applying lath to house studding.	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N							
II	36	Applying corner boards on a house.	U	S	S	S	U	S	U	S	S	S	S	S	S	S	U							
II	37	Assembling basement stairs for a house.	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N							
II	38	Erecting roof and deck framing for a house porch.	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N							
II	39	Laying porch floors for a house.	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N							
		ELECTRICITY EXPERIENCES																						
I	1	Installing boxes for receptacles, switches, junctions and fixtures in a house.	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N							
I	2	Installing wiring from box to box in a house.	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N							
I	3	Connecting receptacles, single throw switches, fixtures and pilot lights to complete circuits in a house.	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N							
II	4	Erecting a temporary service pole for portable electric equipment used in building	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N							

Figure 19, continued

Level	Task No.	Task Statement	Student																					
			A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V
I	5	Installing rigid, thin wall and flexible conduit in a house.	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N							
II	6	Installing a separate circuit for an electric range in a house.	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N							
II	7	Installing grounds for a house wiring system.	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N							
II	8	Installing entrance cable on the exterior of a house.	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N							
II	9	Installing low voltage operated bells and signalling devices in a house.	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N							
II	10	Connecting a hot water heater to a power source in a house.	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N							
II	11	Connecting a water pump to a power source in a house.	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N							
II	12	Installing an attic fan or room cooler in a house.	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N							
		MASONRY EXPERIENCES																						
I	1	Setting up a work area in order to expedite the mixing of concrete on the job.	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N							
I	2	Cleaning and oiling concrete forms prior to and afer their use on a building.	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N							
II	3	Preparing a batch of cement, plaster, lime mortar and cement-lime mortar by hand and by machine at the construction site.	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N							
I	4	Shoring sidewalls of earthen ditches to prevent cave-ins during excavation.	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N							
II	5	Installing rods and spreaders to space form section before pouring cement.	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N							
I	6	Wiring and bolting forms to prevent spreading during pouring.	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N							
II	7	Bracing sidewalls of forms to prevent spreading during pouring.	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N							
I	8	Installing anchor bolts in masonry walls and concrete to provide a place for securing future construction.	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N							
I	9	Protecting a concrete slab following finishing operations to provide for proper curing.	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N							
I	10	Erecting scaffolding for use by a mason at the building site.	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N							
I	11	Cleaning out mortar joints for tuck pointing on a masonry wall.	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N							

Figure 19, continued

Level	Task No.	Task Statement	Student																					
			A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V
I	12	Pointing up a section of a brick wall to provide a finished appearance on a house.	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N							
I	13	Applying colorless coating to waterproof masonry surfaces above grade on a building.	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N							
I	14	Applying asphalt coating to waterproof foundation wall below grade on a building.	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N							
I	15	Pouring a section of footing containing reinforcing rods for a house.	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N							
I	16	Pouring a small reinforced concrete slab suitable for a porch deck on a house.	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N							
II	17	Installing footer forms to receive concrete for a foundation.	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N							
II	18	Setting a section of sidewalk form to receive concrete at a building site.	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N							
II	19	Finishing a small concrete slab to provide utility and pleasing appearance.	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N							
II	20	Laying cement block for a wall in stretcher courses for a building.	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N							
		PAINTING EXPERIENCES																						
I	1	Preparing a surface for application of stain on the interior or exterior of a house.	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S							
I	2	Preparing a surface for application of paint on the interior or exterior of a house.	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S							
II	3	Preparing a surface for application of a clear finish on the interior or exterior of a house.	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S							
I	4	Removing old finishes in preparation for resurfacing.	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S							
I	5	Preparing stain and applicator for use on the interior and exterior of a house.	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S							
II	6	Preparing paint and applicator for use in painting a house.	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S							
I	7	Preparing clear finishes and applicators for use on the exterior and interior of a house.	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S							
I	8	Cleaning and storing brushes and rollers following their use in applying finishing materials.	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S							
I	9	Glazing a window in preparation for painting.	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S							
I	10	Preparing joints and nail holes in dry wall construction to receive final finish	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S							
I	11	Applying finishing materials to provide protection and decoration of surfaces in or on a house	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S							

Figure 19, continued

PLUMBING EXPERIENCES

Level	Task No.	Task Statement	Student																					
			A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V
I	1	Digging a trench for plumbing installation in a house.	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N							
I	2	Backfilling a trench following installation of plumbing lines for a house.	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N							
I	3	Preparing copper tubing for installation in a plumbing system for a house.	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N							
I	4	Preparing pipe for installation in a plumbing or gas supply system in a house.	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N							
I	5	Preparing cast iron soil pipe to pour a lead joint for a waste line in a house.	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N							
I	6	Preparing lead for pouring soil pipe joints for a house.	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N							
I	7	Laying a drainage field with clay pipe for a house.	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N							
I	8	Attaching mounting brackets for plumbing fixtures to frame construction.	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N							
I	9	Attaching mounting brackets for plumbing fixtures to masonry construction.	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N							
I	10	Installing a water closet seat in a house.	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N							
I	11	Insulating heating and water lines in a house.	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N							
I	12	Assembling a furnace for a house.	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N							
I	13	Installing duct work for warm air heating system in a house.	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N							
II	14	Installing plastic pipe for plumbing lines for a house.	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N							
II	15	Soldering sheet metal and copper tubing to be used in a house.	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N							
II	16	Repairing leaks in faucets in a house.	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N							
II	17	Repairing leaks in a water closet in a house.	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N							
II	18	Cleaning waste lines with a snake in a house.	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N							
I	19	Welding angle iron for pipe hangers.	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N							

Figure 19, continued

SUMMARY-EVALUATION OF CLUSTER CONCEPT PILOT PROGRAM

SCHOOL H

	1	2	3	4	5
ADMINISTRATION	The school and county administrative personnel provided minimal moral and material support to the program and the teacher.		The school and county administrative personnel actively supported the program by furnishing the teacher with moral support but with less than satisfactory material support.		The school and county administrative personnel actively supported the program by furnishing the teacher with adequate moral and material support.
TEACHER	Little academic preparation in major field. Little or no teaching experience or practical experience in major field. Seldom shows resourcefulness or initiative.		Adequate academic preparation in major field. Has some teaching experience and some practical experience in major field. Sometime shows resourcefulness and initiative.		Superior academic preparation in major field. An experienced teacher with practical experience in major field. Resourceful. An initiator.
PHYSICAL FACILITIES	The size of the laboratory is inadequate and severely restricts occupational activities. The program also suffers from lack of equipment.		The size of the laboratory is adequate but somewhat restricts occupational activities. The laboratory has the minimum amount of equipment for operating the cluster program.		Size of the laboratory allows unrestricted occupational activities. The laboratory is suitably equipped for the cluster program.
INSTRUCTION	Tasks were taught in only one or two occupations. A very restricted number of Level I tasks were performed by the students. Few experiences offered were appropriate to the cluster.		Tasks were taught in several occupations. A majority of Level I tasks were performed by the students. Experiences were not always appropriate to occupations in the cluster.		Tasks were taught in all occupations. Most Level I tasks were performed by the students. Student experiences were extremely appropriate to occupations in the cluster.
COMMUNITY INVOLVEMENT	Community organizations were unaware of, or did not support the cluster program. Little opportunity for employment was evident in the community.		Community organizations furnished some support to the cluster program. Some members of the class found employment opportunity in the community.		Community organizations cooperated by furnishing aid to the program. A large proportion of the class found employment opportunity in the community.

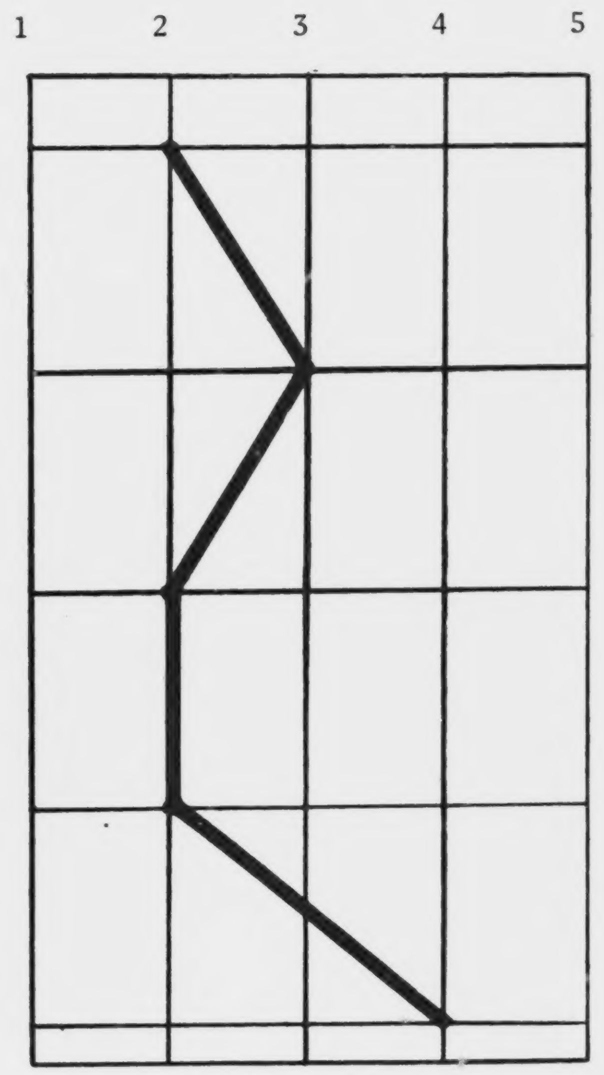


Figure 20.

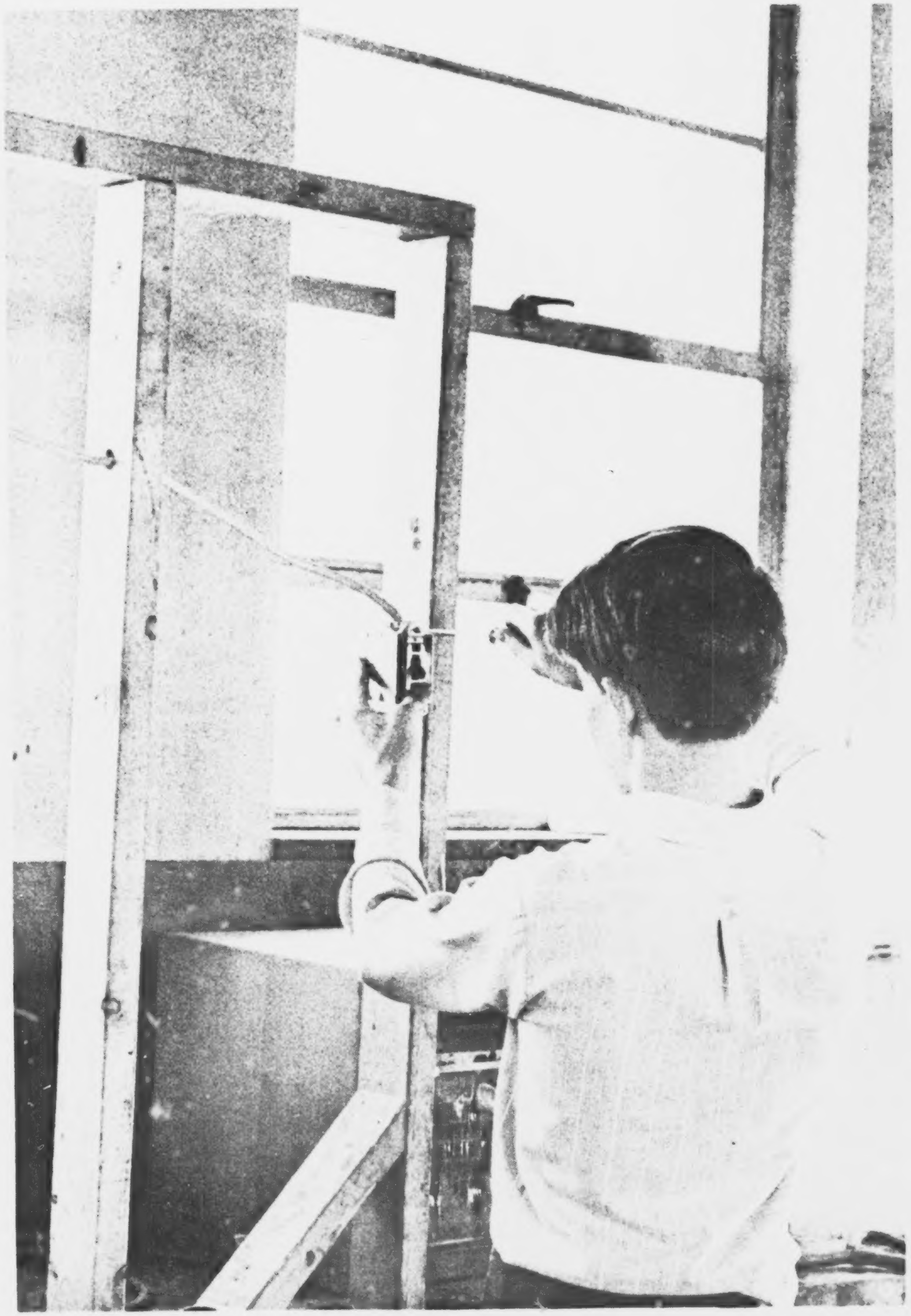
4

PAINTING & CARPENTRY

CARPENTRY

NO-45
MIXING BOX

PLUMBING



ELECTRICITY

MASONRY

MASONRY

EVALUATION OF CLUSTER CONCEPT PILOT PROGRAMS

Metal Forming and Fabrication Cluster

The metal forming and fabrication cluster was designed to develop within the student, skills and understandings related to the occupation of an assembly worker, a machinist, a sheet metal worker, and a welder. The cluster program was not designed for in-depth development of skills in any one occupation, rather it is directed toward preparing students for entry into any of the occupations within the metal forming and fabrication cluster.

The following objectives were emphasized in the curriculum for the metal forming and fabrication cluster:

1. To broaden the student's understanding of the available opportunities in occupations found in the metal forming and fabrication cluster.
2. To develop job entry skills and knowledge for several occupations found in the metal forming and fabrication cluster.
3. To develop a favorable attitude toward work in the metal forming and fabrication cluster.
4. To develop a student's understanding of the sources of information that will be helpful to him as he moves through the occupational area.

The specific objectives for the course are the following:

1. To develop the student's competency in the use of common

hand tools required in the metal forming and fabrication cluster.

2. To develop the student's competency in the use of power tools and equipment needed for job entry into the occupations within the metal forming and fabrication cluster.
3. To develop the student's understanding of the operations, procedures, and processes associated with the metal forming and fabrication cluster.
4. To develop safe working habits related to the occupations within the metal forming and fabrication cluster.
5. To familiarize the student with the terminology associated with the metal forming and fabrication cluster.
6. To develop an understanding of the resources available to him in his pursuit of the course as well as in his work following graduation.

In the following section of the report the pilot program of each school will be discussed with reference to the administration, the teacher, the physical facilities, the instruction, and community involvement.

The information reported was obtained by members of the cluster concept project research team through a series of bi-weekly visitations to the various schools that conducted pilot programs in the metal and and fabrication cluster.

Orientation. School B was located in an urban setting although a number of students were from outlying rural areas. Students in grades 10 through 12 were in attendance. The students could select either the college entrance, business, vocational, or general curriculum.

The introduction of the metal forming and fabrication cluster into this school added another dimension to the practical arts curriculum. In addition to the metal forming and fabrication cluster, the other practical areas of the curriculum included courses in business, home economics, industrial arts, plumbing and heating, graphic arts, and agriculture.

The administration. The principal and vice-principal gave continuous support to the cluster concept program and to the teacher. The administration and guidance counselors were extremely helpful with problems involving the scheduling of students' class time and the allotment of additional physical facilities for the laboratory.

The county administration provided little material support for the cluster concept program during the first semester, although through other overt acts it supported and encouraged the program. Fortunately, Teacher B was able to conduct the program during the first semester with equipment and supplies which were on hand for the industrial arts program so that up until the time when requisitioned material began to arrive, the program was not completely impeded. In April, Teacher B was allotted a sum of money to be used for instructional materials by his supervisor of industrial education. This money was used to purchase additional tools, equipment, and materials needed for the cluster concept program.

In December, the supervisor of industrial education accompanied the principal investigator and the project coordinator on visitations to the schools in his county which were involved in the cluster concept program. However, he did not attend any of the scheduled visitations made by the research assistants to School B.

The teacher. Teacher B had a B.S. degree in Industrial Arts, had completed additional graduate work, plus eight years of teaching experience in woodworking and metal working at the senior high school level. Much of his work experience had been in the area associated with the metal forming and fabrication cluster.

Teacher B was a masterful teacher. His ability to structure experiences and his art of motivating students created the impression that the class would continue to function effectively without his presence. He developed unusual _espirit de corps_ in the groups. For example, he obtained a basketball so that the group could play as a team during the noon hour. The students chose to establish group identity and obtained shop coats with the words "________ High Cluster" embroidered on the back. (To minimize the "Hawthorne" effect, data from a distant school was used for the control group.)

Teacher B's cluster concept program was highly organized throughout the year and he made maximum use of the available tools, materials, and equipment by incorporating several group and individual projects into the practical part of the program. These projects are discussed on the following pages.

Physical facilities. Seventeen boys were enrolled in the metal forming and fabrication cluster in School B. The class shared a laboratory with the agriculture department and utilized the equipment in this facility. This arrangement did not impede the program since the laboratory was of adequate size to provide storage and working space for the group. The laboratory was well-equipped and by the end of the year this feature was enhanced by the addition of several new pieces of equipment. Approximately 50 percent of the tools, materials, and equipment recommended for the cluster were on hand at the beginning of the year. At the end of the school year this was increased to 75 percent.

A detailed drawing of the laboratory in which the cluster program was conducted is shown at the end of this section. This drawing also indicated major pieces of equipment and shows their location in the laboratory. See Illustration 5.

Instruction. From the descriptive data gathered, it was evident that experience was gained by the students in all occupations of the cluster. Various teaching techniques were used. Where required, initial experiences were obtained by completing small jobs and practice pieces. From this initial work the students progressed to larger projects, some of which combined tasks from several occupations. Outstanding products that were constructed included a snowblower, a large barbecue, boat racks, andirons, and auto jacks. In the course of building the products, Teacher B made a practice of rotating students through the occupations of the cluster in groups of three and four.

Field trips were taken during the year to the Goddard Space Flight Center and to the Todd Steel fabrication plant. Students observed many activities which were directly related to the metal forming and fabrication cluster.

In order to evaluate the performance of each student enrolled in the cluster program a task inventory was developed which listed all the tasks to be taught in the metal forming and fabrication cluster as developed in phase I. Kept up-to-date, it represented a record of student progress and achievement to teachers, parents, pupils, and in some instances, employers.

The task evaluation charts located at the end of this section are of two types. One list indicates the tasks which were to be taught in the cluster concept program. Those tasks taught this year are indicated by a check (✓). Those tasks which the teacher feels need to be retaught next

next year are indicated by a double check mark (√√). See Figure 21.

The second evaluation chart indicated, in the teacher's opinion, how each student in his class performed the task. Each student received either a satisfactory (S) or unsatisfactory (U) as an evaluation of his achievement. Those tasks not taught during the first year of pilot programs were indicated by the letter (N). See Figure 22.

Community involvement. Several students obtained employment during the summer within one of the occupations in the cluster. One company agreed to take seven students as part of a work-study program proposed for the 1968-1969 school year.

Teacher B was well respected in the community and the program reaped many benefits in the form of supplies, employment for students, and field trips resulting from his relationship with local industries and businessmen.

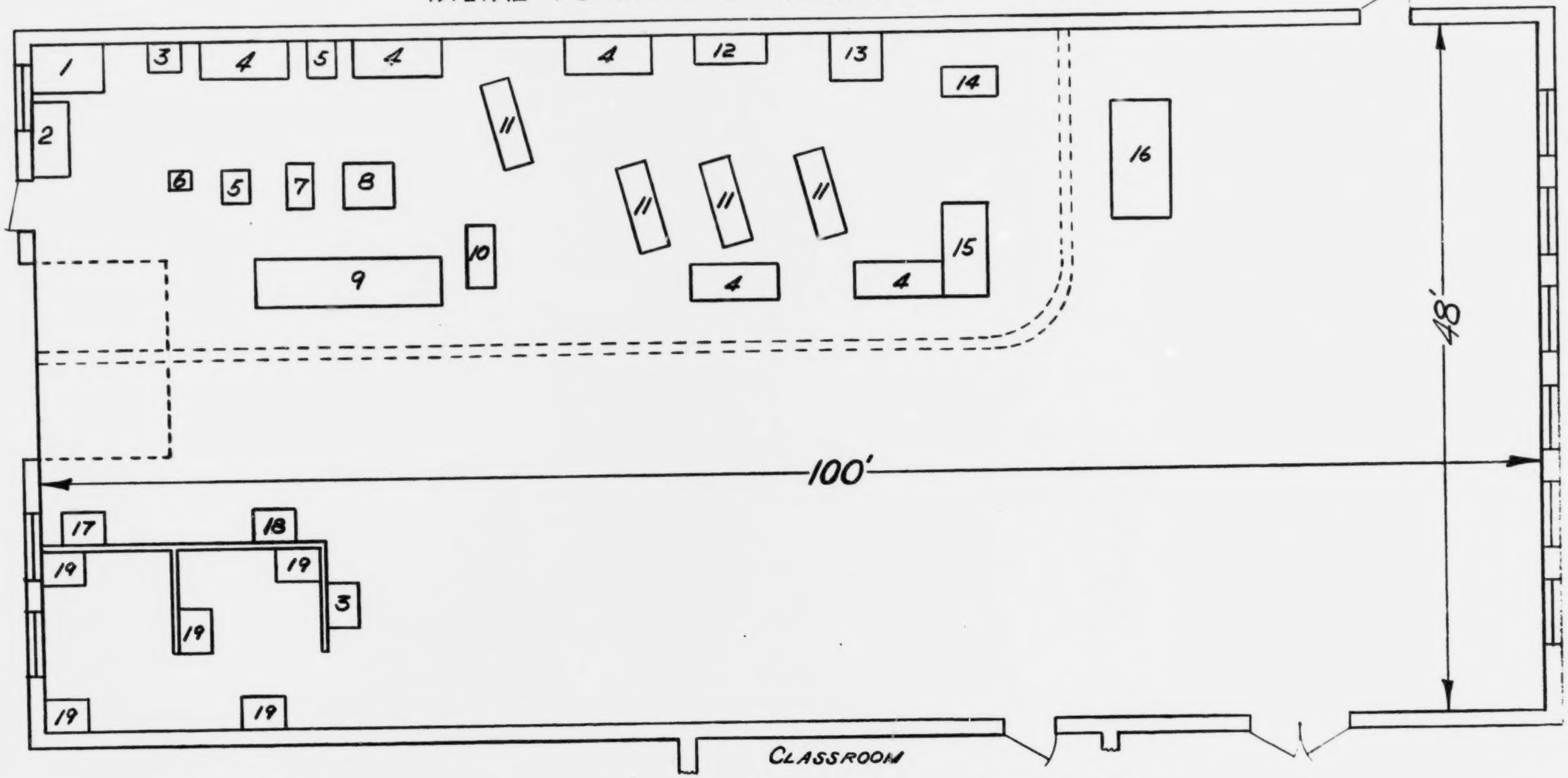
A visual summary of the preceding five areas, administration, teacher, physical facilities, instruction, and community involvement, which have been featured in the description of the pilot program at School B is presented in Figure 23.

Summary and recommendations. The students in the metal forming and fabrication cluster at School B have had the benefit of above average physical facilities and an excellent teacher. See Figure 23. They received instruction in the occupations of the cluster and had well-rounded experiences in project activities as well as on field trips. See Figure 22.

Lack of equipment, especially in the areas of milling, grinding, and sheet metal, curtailed learning in these categories throughout the year. As a result, a recommendation was advanced that this equipment be available to the cluster program no later than the beginning of the second semester of the 1968-1969 school year. Without it, it will be impossible to teach and to gain experience in a large number of tasks in the areas of machining and sheet metal, two of the four major occupations in this cluster.

SCHOOL B

METAL FORMING & FABRICATION CLUSTER


1
3
4
5
4
4
12
13
14
2
6
5
7
8
11
11
11
11
16
9
10
4
4
15
48'
100'
17
18
19
19
3
19
19
19
CLASSROOM

1. FORGE
2. SOLDERING TABLE
3. GRINDER
4. WORK BENCH
5. DRILL PRESS
6. ARBOR PRESS
7. BAND SAW
8. SHAPER
9. METAL STORAGE RACK
10. HACK SAW
11. METAL LATHE
12. AIR COMPRESSOR
13. MILLING MACHINE
14. SQUARING SHEARS
15. TOOL LOCKER
16. SHEET METAL BENCH
17. TIG WELDER
18. OXY-ACETYLENE WELDER
19. ARC WELDER

ILLUSTRATION 5

TASK EVALUATION CHART

MACHINING EXPERIENCES

Level	Task No.	Task Statement	
I	1	Turning stock on lathe to produce a faced surface.	✓
I	2	Countersinking (countersink and center drill) stock to produce a tapered hole for mounting stock between centers.	✓
I	3	Turning stock on lathe to produce a cyclindrical shape to .001 inch.	✓
I	4	Turning stock on lathe to produce a shoulder to .001 of an inch.	✓✓
I	5	Drilling stock on lathe to produce a hole to .005 of an inch.	✓
II	6	Reaming stock on lathe to produce a finished hole to .001 of an inch.	✓
II	7	Boring stock on lathe to produce an enlarged hole to .001 of an inch.	✓
II	8	Counterboring stock on lathe to produce a recessed hole to .005 of an inch.	✓
I	9	Parting stock on lathe to produce a piece within 1/32 of an inch.	✓✓
II	10	Necking stock on lathe to produce a necked shape to 1/32 of an inch.	✓
I	11	Filing stock on lathe to produce a finished surface.	
I	12	Machining stock on shaper to produce a flat surface.	✓✓
I	13	Machining stock on shaper to produce two parallel surfaces to .005 of an inch.	
I	14	Drilling stock on drill press to produce a hole to .005 of an inch.	
II	15	Reaming a hole on drill press to produce a finished hole to .001 of an inch.	✓
I	16	Spot facing a hole on drill press to produce a finished surface to .005 of an inch.	✓✓
I	17	Countersinking on drill press to produce a fastener receiver hole.	
II	18	Counterboring stock on drill press to produce an enlarged hole to .005 of an inch.	✓✓
I	19	Grinding stock on bench grinder to remove excess metal.	
I	20	Grinding drill bits on a bench grinder to sharpen tools.	✓✓
I	21	Grinding stock on surface grinder to produce a flat surface.	✓
I	22	Grinding stock on surface grinder to produce two parallel surfaces to .001 of an inch.	✓
II	23	Grinding stock on surface grinder to produce two perpendicular surfaces to .001 of an inch.	✓
II	24	Grinding stock on surface grinder to produce an angular surface.	✓
I	25	Machining stock on a horizontal milling machine to produce a flat surface.	✓
I	26	Machining stock on a horizontal milling machine to produce parallel surfaces to .001 of an inch.	✓
II	27	Machining stock on a horizontal milling machine to produce two perpendicular surfaces to .001 of an inch.	✓
II	28	Machining stock on a horizontal milling machine to produce a shoulder to .001 of an inch.	✓
II	29	Machining stock on a horizontal milling machine to produce an angular surface.	✓
I	30	Machining stock on a vertical milling machine to produce a flat surface.	✓
I	31	Machining stock on a vertical milling machine to produce two parallel surfaces to .001 of an inch.	✓
II	32	Machining stock on vertical milling machine to produce two perpendicular surfaces to .001 of an inch.	✓
II	33	Machining stock on vertical milling machine to produce a shoulder to .001 of an inch.	✓
		WELDING EXPERIENCES	
		Arc welding ferrous metals with A.C. welder to produce:	
I	1	a horizontal butt joint.	✓
I	2	a horizontal lap joint.	✓
I	3	a horizontal outside corner joint.	✓
I	4	a horizontal inside corner joint.	✓✓
I	5	a horizontal tee joint.	✓✓
I	6	a vertical lap joint.	
II	7	Arc welding pipe stock with A.C. welder to produce a butt joint while fixed.	✓
II	8	Arc welding pipe stock with A.C. welder to produce butt joints while rolling.	✓

Figure 21.

Level	Task No.	Task Statement	
		Arc welding ferrous metals with D.C. welder to produce	
I	9	a horizontal butt joint.	
I	10	a horizontal lap joint.	
I	11	a horizontal outside corner joint.	
I	12	a horizontal inside corner joint.	✓✓
I	13	a horizontal tee joint.	
I	14	a vertical lap joint.	
II	15	Arc welding pipe stock with D.C. welder to produce butt joints while fixed.	✓✓
II	16	Arc welding pipe stock with D.C. welder to produce butt joints while rolling.	✓
I	17	Pad welding low areas on metal stock to renew stock to original height.	
		Gas welding ferrous metals stock to produce:	
I	18	a horizontal butt joint.	
I	19	a horizontal lap joint.	✓✓
I	20	a horizontal outside corner joint.	
I	21	a horizontal inside corner joint.	
I	22	a horizontal tee joint.	✓✓
I	23	a vertical lap joint.	✓✓
I	24	Gas cutting ferrous carbon steels.	
		Brazing ferrous metals to produce:	
I	25	a horizontal butt joint.	
I	26	a horizontal lap joint.	
I	27	a horizontal outside corner joint.	
I	28	a horizontal inside corner joint.	
I	29	a horizontal tee joint.	✓✓
I	30	a vertical lap joint.	
		Brazing non-ferrous metals to produce:	
II	31	a horizontal butt joint.	✓
II	32	a horizontal lap joint.	✓
II	33	a horizontal outside corner joint.	✓
II	34	a horizontal inside corner joint.	✓
II	35	a horizontal tee joint.	✓
II	36	a vertical lap joint.	✓

Level	Task No.	Task Statement	
		Inert gas welding ferrous metals to produce:	
II	37	a horizontal butt joint.	✓✓
II	38	a horizontal lap joint.	✓✓
II	39	a horizontal outside corner joint.	✓✓
II	40	a horizontal inside corner joint.	✓
II	41	a horizontal tee joint.	
II	42	a vertical lap joint.	✓
II	43	Inert gas welding pipe stock to produce butt joints while rolling.	✓
II	44	Inert gas welding pipe stock to produce butt joints while fixed.	✓
		Inert gas welding non-ferrous metals to produce:	
II	45	a horizontal butt joint.	✓✓
II	46	a horizontal lap joint.	✓✓
II	47	a horizontal outside corner joint.	✓
II	48	a horizontal inside corner joint.	✓
II	49	a horizontal tee joint.	✓✓
II	50	a vertical lap joint.	✓
II	51	butt joints while rolling	✓
II	52	butt joints while fixed	✓
		SHEET METAL EXPERIENCES	
I	1	Tracing templates on sheet metal for cutting, bending and joining sheet metal items.	
I	2	Cutting sheet metal with hand tools to produce a straight cut within 1/32 of an inch.	
II	3	Cutting sheet metal with machinery to produce a straight cut within 1/32 of an inch.	
I	4	Cutting sheet metal with hand tools to produce a circular cut within 1/32 of an inch.	
II	5	Cutting sheet metal with machinery to produce a circular cut within 1/32 of an inch.	✓
I	6	Cutting sheet metal with hand tools to produce an irregular cut within 1/32 of an inch.	✓✓
II	7	Cutting sheet metal with machinery to produce an irregular cut within 1/32 of an inch.	✓
I	8	Cutting sheet metal with hand tools to produce a notched cut within 1/32 of an inch.	✓✓

Figure 21, continued

Level	Task No.	Task Statement	
II	9	Cutting sheet metal with machinery to produce a notched cut within 1/32 of an inch.	✓
I	10	Cutting sheet metal to produce an interior cut within 1/32 of an inch.	✓✓
II	11	Forming sheet metal cylindrical shapes on slip roll forming machine.	✓✓
I	12	Forming sheet metal crimping on a crimping machine.	✓
I	13	Forming sheet metal beading on a beading machine.	✓
II	14	Forming single hem on bar folder or brake for strength.	✓✓
II	15	Forming double hem on bar folder or brake for strength.	✓
II	16	Forming single seam on a brake and/or bar folder for joining sheet metal parts.	✓
II	17	Forming double seam on a brake and/or bar folder for joining sheet metal parts.	✓
II	18	Forming Pittsburgh lock seam with machinery for joining sheet metal parts.	✓
II	19	Forming cap strip seam on a drive cap machine for joining sheet metal parts.	✓
I	20	Drilling sheet metal to produce a fastener receiver hole.	
II	21	Adhering sheet metal parts with adhesives to produce an assembly.	✓
II	22	Welding (spot) sheet metal parts to produce an assembly.	✓
II	23	Soldering sheet metal parts to produce an assembly.	✓✓
I	24	Fastening sheet metal parts with sheet metal screws to produce an assembly.	
[illegible]	25	Bolting sheet metal parts to produce an assembly.	
II	26	Riveting sheet metal parts to produce an assembly.	✓✓
[illegible]	27	Joining sheet metal parts with seams.	✓✓
		ASSEMBLY EXPERIENCES	
[illegible]	1	Adhering parts with adhesives using hand processes to produce a metal bonded assembly	✓
II	2	Adhering parts with adhesives using spray equipment to a specified thickness to produce a metal bonded assembly.	✓

Figure 21, continued

Level	Task No.	Task Statement	
I	3	Fastening metal parts with screws to produce an assembly.	
I	4	Bolting metal parts with screws to produce an assembly.	
I	5	Riveting metal parts to produce an assembly.	✓✓
I	6	Tightening metal fasteners with hand power tools.	✓✓
II	7	Mating parts together to produce sub-assemblies.	✓
II	8	Mating parts and sub-assemblies together to produce major assemblies.	✓
I	9	Holding parts in clamping devices for assembly of details, sub-assemblies and assemblies.	✓✓
II	10	Cutting materials with hand tools to fit in an assembly.	✓✓
II	11	Cutting materials with power tools to fit in an assembly to 1/32 of an inch.	
I	12	Filing stock to produce a finished assembly to .001 of an inch.	
I	13	Drilling holes in material with hand drill to produce a hole to .005 of an inch.	
I	14	Drilling holes with a hand power drill to produce a hole to .005 of an inch.	
II	15	Reaming stock with hand wrench to produce a finished hole to .001 of an inch.	✓
II	16	Reaming stock with power drill to produce a finished hole to .001 of an inch.	✓
I	17	Countersinking holes with hand tools to produce a fastener receiver hole.	
I	18	Countersinking holes with power drill to produce a fastener receiver hole.	
II	19	Tapping holes with taps to produce a threaded hole.	
II	20	Cutting threads with dies to produce a threaded member.	
II	21	Punching materials with hand punches to produce a hole.	✓
II	22	Punching materials with power tools to produce an assembly.	✓

Level	Task No.	Task Statement	
I	23	Checking dimensions of details with precision instruments for accurate assembly.	
I	24	Checking dimensions of sub-assemblies and assemblies to produce accurate assemblies.	✓✓
II	25	Measuring stock with precision instruments for assembly.	✓✓
I	26	Stamping number and letters on metal stock for identification.	
I	27	Hammering appropriate metal parts with various hammers.	
II	28	Flaring metal tubing with a flaring tool to produce a flare.	✓
II	29	Aligning parts in sub-assemblies and assemblies with hand tools.	✓

Figure 21, continued

TASK EVALUATION CHART

MACHINING EXPERIENCES

			Student																					
Level	Task No.	Task Statement	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V
I	1	Turning stock on lathe to produce a faced surface.	S	S	S	S	S	S	S	S	S	S	S	S	S	S								
I	2	Countersinking (countersink and center drill) stock to produce a tapered hole for mounting stock between centers.	S	S	S	S	S	S	S	S	S	S	S	S	S	S								
I	3	Turning stock on lathe to produce a cyclindrical shape to .001 inch.	S	S	S	S	S	S	S	S	S	S	S	S	S	S								
I	4	Turning stock on lathe to produce a shoulder to .001 of an inch.	U	U	U	U	U	U	U	S	U	U	S	U	U	U								
I	5	Drilling stock on lathe to produce a hole to .005 of an inch.	S	S	S	S	S	S	S	S	S	S	S	S	S	S								
II	6	Reaming stock on lathe to produce a finished hole to .001 of an inch.	S	S	S	S	S	S	S	S	S	S	S	S	S	S								
II	7	Boring stock on lathe to produce an enlarged hole to .001 of an inch.	S	S	S	S	S	S	S	S	S	S	S	S	S	S								
II	8	Counterboring stock on lathe to produce a recessed hole to .005 of an inch.	S	S	S	S	S	S	S	S	S	S	S	S	S	S								
I	9	Parting stock on lathe to produce a piece within 1/32 of an inch.	U	S	U	U	S	U	U	S	U	U	S	U	U	U								
II	10	Necking stock on lathe to produce a necked shape to 1/32 of an inch.	S	S	S	S	S	S	S	S	S	S	S	S	S	S								
I	11	Filing stock on lathe to produce a finished surface.	N	N	N	N	N	N	N	N	N	N	N	N	N	N								
I	12	Machining stock on shaper to produce a flat surface.	S	S	S	S	U	U	S	S	U	U	S	S	S	S								
I	13	Machining stock on shaper to produce two parallel surfaces to .005 of an inch.	N	N	N	N	N	N	N	N	N	N	N	N	N	N								
I	14	Drilling stock on drill press to produce a hole to .005 of an inch.	N	N	N	N	N	N	N	N	N	N	N	N	N	N								
II	15	Reaming a hole on drill press to produce a finished hole to .001 of an inch.	S	S	S	S	S	S	S	S	S	S	S	S	S	S								
I	16	Spot facing a hole on drill press to produce a finished surface to .005 of an inch.	S	S	U	S	S	S	S	S	U	S	S	S	S	S								
I	17	Countersinking on drill press to produce a fastener receiver hole.	N	N	N	N	N	N	N	N	N	N	N	N	N	N								
II	18	Counterboring stock on drill press to produce an enlarged hole to .005 of an inch.	U	U	S	S	S	S	U	S	U	U	U	S	U	U								
I	19	Grinding stock on bench grinder to remove excess metal.	N	N	N	N	N	N	N	N	N	N	N	N	N	N								
I	20	Grinding drill bits on a bench grinder to sharpen tools.	U	U	U	S	U	S	U	U	S	S	U	U	U	U								

Figure 22.

			Student																					
Level	Task No.	Task Statement	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V
I	21	Grinding stock on surface grinder to produce a flat surface.	S	S	S	S	S	S	S	S	S	S	S	S	S	S								
I	22	Grinding stock on surface grinder to produce two parallel surfaces to .001 of an inch.	S	S	S	S	S	S	S	S	S	S	S	S	S	S								
II	23	Grinding stock on surface grinder to produce two perpendicular surfaces to .001 of an inch.	S	S	S	S	S	S	S	S	S	S	S	S	S	S								
II	24	Grinding stock on surface grinder to produce an angular surface.	S	S	S	S	S	S	S	S	S	S	S	S	S	S								
I	25	Machining stock on a horizontal milling machine to produce a flat surface.	S	S	S	S	S	S	S	S	S	S	S	S	S	S								
I	26	Machining stock on a horizontal milling machine to produce parallel surfaces to .001 of an inch.	S	S	S	S	S	S	S	S	S	S	S	S	S	S								
II	27	Machining stock on a horizontal milling machine to produce two perpendicular surfaces to .001 of an inch.	S	S	S	S	S	S	S	S	S	S	S	S	S	S								
II	28	Machining stock on a horizontal milling machine to produce a shoulder to .001 of an inch.	S	S	S	S	S	S	S	S	S	S	S	S	S	S								
II	29	Machining stock on a horizontal milling machine to produce an angular surface.	S	S	S	S	S	S	S	S	S	S	S	S	S	S								
I	30	Machining stock on a vertical milling machine to produce a flat surface.	S	S	S	S	S	S	S	S	S	S	S	S	S	S								
I	31	Machining stock on a vertical milling machine to produce two parallel surfaces to .001 of an inch.	S	S	S	S	S	S	S	S	S	S	S	S	S	S								
II	32	Machining stock on vertical milling machine to produce two perpendicular surfaces to .001 of an inch.	S	S	S	S	S	S	S	S	S	S	S	S	S	S								
II	33	Machining stock on vertical milling machine to produce a shoulder to .001 of an inch.	S	S	S	S	S	S	S	S	S	S	S	S	S	S								
		WELDING EXPERIENCES																						
		Arc welding ferrous metals with A.C. welder to produce:																						
I	1	a horizontal butt joint.	S	S	S	S	S	S	S	S	S	S	S	S	S	S								
I	2	a horizontal lap joint.	S	S	S	S	S	S	S	S	S	S	S	S	S	S								
I	3	a horizontal outside corner joint.	S	S	S	S	S	S	S	S	S	S	S	S	S	S								
I	4	a horizontal inside corner joint.	U	S	U	U	U	U	U	U	S	U	U	U	U	U								
I	5	a horizontal tee joint.	U	U	U	U	U	U	S	U	U	U	U	U	U	U								
I	6	a vertical lap joint.	N	N	N	N	N	N	N	N	N	N	N	N	N	N								
II	7	Arc welding pipe stock with A.C. welder to produce a butt joint while fixed.	S	S	S	U	S	S	S	S	S	S	S	S	S	S								
II	8	Arc welding pipe stock with A.C. welder to produce butt joints while rolling.	S	S	S	S	S	S	S	S	S	S	S	S	S	S								

Figure 22, continued

Student

Level	Task No.	Task Statement	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V
		Arc welding ferrous metals with D.C. welder to produce																						
I	9	a horizontal butt joint.	N	N	N	N	N	N	N	N	N	N	N	N	N	N								
I	10	a horizontal lap joint.	N	N	N	N	N	N	N	N	N	N	N	N	N	N								
I	11	a horizontal outside corner joint.	N	N	N	N	N	N	N	N	N	N	N	N	N	N								
I	12	a horizontal inside corner joint.	U	U	U	S	U	U	S	U	U	U	U	S	U	U								
I	13	a horizontal tee joint.	N	N	N	N	N	N	N	N	N	N	N	N	N	N								
I	14	a vertical lap joint.	N	N	N	N	N	N	N	N	N	N	N	N	N	N								
II	15	Arc welding pipe stock with D.C. welder to produce butt joints while fixed.	U	S	S	U	S	S	S	S	U	U	S	S	S	S								
II	16	Arc welding pipe stock with D.C. welder to produce butt joints while rolling.	S	S	S	S	S	S	S	S	S	S	S	S	S	S								
I	17	Pad welding low areas on metal stock to renew stock to original height.	N	N	N	N	N	N	N	N	N	N	N	N	N	N								
		Gas welding ferrous metals stock to produce:																						
I	18	a horizontal butt joint.	N	N	N	N	N	N	N	N	N	N	N	N	N	N								
I	19	a horizontal lap joint.	U	U	S	U	U	U	S	U	S	U	S	U	U	U								
I	20	a horizontal outside corner joint.	N	N	N	N	N	N	N	N	N	N	N	N	N	N								
I	21	a horizontal inside corner joint.	N	N	N	N	N	N	N	N	N	N	N	N	N	N								
I	22	a horizontal tee joint.	U	U	S	S	S	U	S	U	U	U	S	U	U	S								
I	23	a vertical lap joint.	S	S	S	U	S	S	U	U	S	S	U	S	S	U								
I	24	Gas cutting ferrous carbon steels.	N	N	N	N	N	N	N	N	N	N	N	N	N	N								
		Brazing ferrous metals to produce:																						
I	25	a horizontal butt joint.	N	N	N	N	N	N	N	N	N	N	N	N	N	N								
I	26	a horizontal lap joint.	N	N	N	N	N	N	N	N	N	N	N	N	N	N								
I	27	a horizontal outside corner joint.	N	N	N	N	N	N	N	N	N	N	N	N	N	N								
I	28	a horizontal inside corner joint.	N	N	N	N	N	N	N	N	N	N	N	N	N	N								
I	29	a horizontal tee joint.	S	S	S	S	S	S	S	S	U	U	S	S	S	S								
I	30	a vertical lap joint.	N	N	N	N	N	N	N	N	N	N	N	N	N	N								
		Brazing non-ferrous metals to produce:																						
II	31	a horizontal butt joint.	S	S	S	S	S	S	S	S	S	S	S	S	S	S								
II	32	a horizontal lap joint.	S	S	S	S	S	S	S	S	S	S	S	S	S	S								
II	33	a horizontal outside corner joint.	S	S	S	S	S	S	S	S	S	S	S	S	S	S								
II	34	a horizontal inside corner joint.	S	S	S	S	S	S	S	S	S	S	S	S	S	S								
II	35	a horizontal tee joint.	S	S	S	S	S	S	S	S	S	S	S	S	S	S								
II	36	a vertical lap joint.	S	S	S	S	S	S	S	S	S	S	S	S	S	S								

Figure 22, continued

Student

Level	Task No.	Task Statement	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V
		Inert gas welding ferrous metals to produce:																						
II	37	a horizontal butt joint.	U	U	S	U	S	S	S	S	S	U	S	S	U	U								
II	38	a horizontal lap joint.	U	U	S	U	U	U	S	S	S	U	S	S	U	U								
II	39	a horizontal outside corner joint.	U	S	S	U	S	S	S	S	U	S	S	S	S	S								
II	40	a horizontal inside corner joint.	S	S	S	S	S	S	S	S	S	S	S	S	S	S								
II	41	a horizontal tee joint.	N	N	N	N	N	N	N	N	N	N	N	N	N	N								
II	42	a vertical lap joint.	S	S	S	S	S	S	S	S	S	S	S	S	S	S								
II	43	Inert gas welding pipe stock to produce butt joints while rolling.	S	S	S	S	S	S	S	S	S	S	S	S	S	S								
II	44	Inert gas welding pipe stock to produce butt joints while fixed.	S	S	S	S	S	S	S	S	S	S	S	S	S	S								
	.	Inert gas welding non-ferrous metals to produce:																						
II	45	a horizontal butt joint.	U	U	S	S	S	S	S	S	U	U	S	U	U	S								
II	46	a horizontal lap joint.	U	U	S	S	S	S	S	S	U	U	S	U	U	S								
II	47	a horizontal outside corner joint.	S	S	S	S	S	S	S	S	S	S	S	S	S	S								
II	48	a horizontal inside corner joint.	S	S	S	S	S	S	S	S	S	S	S	S	S	S								
II	49	a horizontal tee joint.	U	U	S	S	S	S	S	S	U	U	S	U	U	S								
II	50	a vertical lap joint.	S	S	S	S	S	S	S	S	S	S	S	S	S	S								
II	51	butt joints while rolling	S	S	S	S	S	S	S	S	S	S	S	S	S	S								
II	52	butt joints while fixed	S	S	S	S	S	S	S	S	S	S	S	S	S	S								
		SHEET METAL EXPERIENCES																						
I	1	Tracing templates on sheet metal for cutting, bending and joining sheet metal items.	N	N	N	N	N	N	N	N	N	N	N	N	N	N								
I	2	Cutting sheet metal with hand tools to produce a straight cut within 1/32 of an inch.	N	N	N	N	N	N	N	N	N	N	N	N	N	N								
II	3	Cutting sheet metal with machinery to produce a straight cut within 1/32 of an inch.	N	N	N	N	N	N	N	N	N	N	N	N	N	N								
I	4	Cutting sheet metal with hand tools to produce a circular cut within 1/32 of an inch.	N	N	N	N	N	N	N	N	N	N	N	N	N	N								
II	5	Cutting sheet metal with machinery to produce a circular cut within 1/32 of an inch.	S	S	S	S	S	S	S	S	S	S	S	S	S	S								
I	6	Cutting sheet metal with hand tools to produce an irregular cut within 1/32 of an inch.	U	U	U	S	U	U	S	U	S	S	U	U	U	S								
II	7	Cutting sheet metal with machinery to produce an irregular cut within 1/32 of an inch.	S	S	S	S	S	S	S	S	S	S	S	S	S	S								
I	8	Cutting sheet metal with hand tools to produce a notched cut within 1/32 of an inch.	U	U	S	U	S	U	S	U	S	U	U	S	S	U								

Figure 22, continued

Level	Task No.	Task Statement	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V
II	9	Cutting sheet metal with machinery to produce a notched cut within 1/32 of an inch.	S	S	S	S	S	S	S	S	S	S	S	S	S	S								
I	10	Cutting sheet metal to produce an interior cut within 1/32 of an inch.	U	S	S	U	S	U	S	S	S	U	U	U	S	S								
II	11	Forming sheet metal cylindrical shapes on slip roll forming machine.	U	S	U	S	S	S	S	U	U	U	U	U	U	S								
I	12	Forming sheet metal crimping on a crimping machine.	S	S	S	S	S	S	S	S	S	S	S	S	S	S								
I	13	Forming sheet metal beading on a beading machine.	S	S	S	S	S	S	S	S	S	S	S	S	S	S								
II	14	Forming single hem on bar folder or brake for strength.	U	S	U	S	S	U	U	U	S	U	U	U	S	S								
II	15	Forming double hem on bar folder or brake for strength.	S	S	S	S	S	S	S	S	S	S	S	S	S	S								
II	16	Forming single seam on a brake and/or bar folder for joining sheet metal parts.	S	S	S	S	S	S	S	S	S	S	S	S	S	S								
II	17	Forming double seam on a brake and/or bar folder for joining sheet metal parts.	S	S	S	S	S	S	S	S	S	S	S	S	S	S								
II	18	Forming Pittsburgh lock seam with machinery for joining sheet metal parts.	S	S	S	S	S	S	S	S	S	S	S	S	S	S								
II	19	Forming cap strip seam on a drive cap machine for joining sheet metal parts.	S	S	S	S	S	S	S	S	S	S	S	S	S	S								
I	20	Drilling sheet metal to produce a fastener receiver hole.	N	N	N	N	N	N	N	N	N	N	N	N	N	N								
II	21	Adhering sheet metal parts with adhesives to produce an assembly.	S	S	S	S	S	S	S	S	S	S	S	S	S	S								
II	22	Welding (spot) sheet metal parts to produce an assembly.	S	S	S	S	S	S	S	S	S	S	S	S	S	S								
II	23	Soldering sheet metal parts to produce an assembly.	U	U	S	S	S	S	U	S	U	U	S	S	S	U								
I	24	Fastening sheet metal parts with sheet metal screws to produce an assembly.	N	N	N	N	N	N	N	N	N	N	N	N	N	N								
[illegible]	25	Bolting sheet metal parts to produce an assembly.	N	N	N	N	N	N	N	N	N	N	N	N	N	N								
II	26	Riveting sheet metal parts to produce an assembly.	U	U	S	U	S	U	U	S	U	U	U	S	S	U								
[illegible]	27	Joining sheet metal parts with seams.	U	U	S	S	S	U	S	S	U	U	S	U	U	S								
		ASSEMBLY EXPERIENCES																						
[illegible]	1	Adhering parts with adhesives using hand processes to produce a metal bonded assembly	S	S	S	S	S	S	S	S	S	S	S	S	S	S								
II	2	Adhering parts with adhesives using spray equipment to a specified thickness to produce a metal bonded assembly.	S	S	S	S	S	S	S	S	S	S	S	S	S	S								

Figure 22, continued

Level	Task No.	Task Statement	Student																					
			A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V
I	3	Fastening metal parts with screws to produce an assembly.	N	N	N	N	N	N	N	N	N	N	N	N	N	N								
I	4	Bolting metal parts with screws to produce an assembly.	N	N	N	N	N	N	N	N	N	N	N	N	N	N								
I	5	Riveting metal parts to produce an assembly.	U	S	U	U	S	S	U	U	U	U	U	U	U	S								
I	6	Tightening metal fasteners with hand power tools.	S	S	U	S	S	U	S	U	U	U	U	U	S	S								
II	7	Mating parts together to produce sub-assemblies.	S	S	S	S	S	S	S	S	S	S	S	S	S	S								
II	8	Mating parts and sub-assemblies together to produce major assemblies.	S	S	S	S	S	S	S	S	S	S	S	S	S	S								
I	9	Holding parts in clamping devices for assembly of details, sub-assemblies and assemblies.	U	U	S	U	U	U	U	U	S	U	U	U	S	U								
II	10	Cutting materials with hand tools to fit in an assembly.	S	S	S	U	U	S	U	S	U	U	S	S	U	U								
II	11	Cutting materials with power tools to fit in an assembly to 1/32 of an inch.	U	U	S	U	S	S	U	U	U	U	S	S	S	S								
I	12	Filing stock to produce a finished assembly to .001 of an inch.	N	N	N	N	N	N	N	N	N	N	N	N	N	N								
I	13	Drilling holes in material with hand drill to produce a hole to .005 of an inch.	N	N	N	N	N	N	N	N	N	N	N	N	N	N								
I	14	Drilling holes with a hand power drill to produce a hole to .005 of an inch.	N	N	N	N	N	N	N	N	N	N	N	N	N	N								
II	15	Reaming stock with hand wrench to produce a finished hole to .001 of an inch.	S	S	S	S	S	S	S	S	S	S	S	S	S	S								
II	16	Reaming stock with power drill to produce a finished hole to .001 of an inch.	S	S	S	S	S	S	S	S	S	S	S	S	S	S								
I	17	Countersinking holes with hand tools to produce a fastener receiver hole.	N	N	N	N	N	N	N	N	N	N	N	N	N	N								
I	18	Countersinking holes with power drill to produce a fastener receiver hole.	N	N	N	N	N	N	N	N	N	N	N	N	N	N								
II	19	Tapping holes with taps to produce a threaded hole.	N	N	N	N	N	N	N	N	N	N	N	N	N	N								
II	20	Cutting threads with dies to produce a threaded member.	N	N	N	N	N	N	N	N	N	N	N	N	N	N								
II	21	Punching materials with hand punches to produce a hole.	S	S	S	S	S	S	S	S	S	S	S	S	S	S								
II	22	Punching materials with power tools to produce an assembly.	S	S	S	S	S	S	S	S	S	S	S	S	S	S								

Figure 22, continued

Level	Task No.	Task Statement	Student																					
			A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V
I	23	Checking dimensions of details with precision instruments for accurate assembly.	N	N	N	N	N	N	N	N	N	N	N	N	N	N								
I	24	Checking dimensions of sub-assemblies and assemblies to produce accurate assemblies.	S	U	S	S	S	U	U	S	S	U	U	U	U	S								
II	25	Measuring stock with precision instruments for assembly.	S	S	S	S	S	S	S	S	S	U	U	S	S	S								
I	26	Stamping number and letters on metal stock for identification.	N	N	N	N	N	N	N	N	N	N	N	N	N	N								
I	27	Hammering appropriate metal parts with various hammers.	N	N	N	N	N	N	N	N	N	N	N	N	N	N								
II	28	Flaring metal tubing with a flaring tool to produce a flare.	S	S	S	S	S	S	S	S	S	S	S	S	S	S								
II	29	Aligning parts in sub-assemblies and assemblies with hand tools.	S	S	S	S	S	S	S	S	S	S	S	S	S	S								

Fibure 22, continued

SUMMARY-EVALUATION OF CLUSTER CONCEPT PILOT PROGRAM

SCHOOL B

1	2	3	4	5
ADMINISTRATION The school and county administrative personnel provided minimal moral and material support to the program and the teacher.		The school and county administrative personnel actively supported the program by furnishing the teacher with moral support but with less than satisfactory material support.		The school and county administrative personnel actively supported the program by furnishing the teacher with adequate moral and material support.
TEACHER Little academic preparation in major field. Little or no teaching experience or practical experience in major field. Seldom shows resourcefulness or initiative.		Adequate academic preparation in major field. Has some teaching experience and some practical experience in major field. Sometime shows resourcefulness and initiative.		Superior academic preparation in major field. An experienced teacher with practical experience in major field. Resourceful. An initiator.
PHYSICAL FACILITIES The size of the laboratory is inadequate and severely restricts occupational activities. The program also suffers from lack of equipment.		The size of the laboratory is adequate but somewhat restricts occupational activities. The laboratory has the minimum amount of equipment for operating the cluster program.		Size of the laboratory allows unrestricted occupational activities. The laboratory is suitably equipped for the cluster program.
INSTRUCTION Tasks were taught in only one or two occupations. A very restricted number of Level I tasks were performed by the students. Few experiences offered were appropriate to the cluster.		Tasks were taught in several occupations. A majority of Level I tasks were performed by the students. Experiences were not always appropriate to occupations in the cluster.		Tasks were taught in all occupations. Most Level I tasks were performed by the students. Student experiences were extremely appropriate to occupations in the cluster.
COMMUNITY INVOLVEMENT Community organizations were unaware of, or did not support the cluster program. Little opportunity for employment was evident in the community.		Community organizations furnished some support to the cluster program. Some members of the class found employment opportunity in the community.		Community organizations cooperated by furnishing aid to the program. A large proportion of the class found employment opportunity in the community.

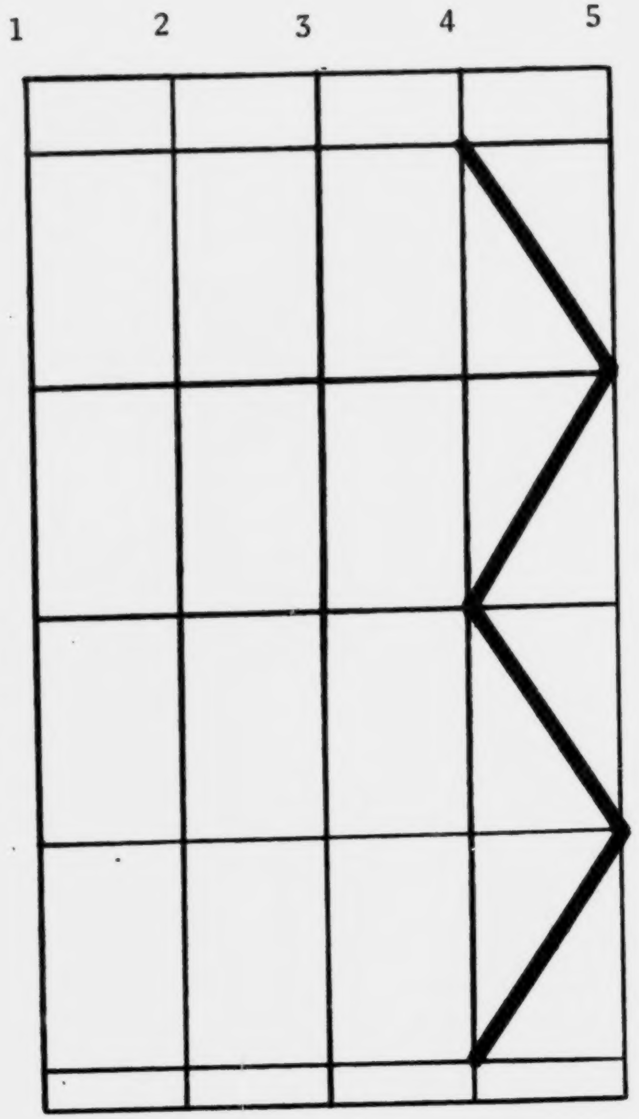


Figure 23.

Orientation. School D was a comprehensive high school composed of grades 10 through 12, located in an urban community. The school program consisted of college entrance, general, business, and vocational curriculum. Students entering grade 10 selected one of these programs which they followed for the remainder of their high school career.

In addition to the areas of home economics and business, the other vocational programs in School D included automotives, painting and interior decorating, carpentry, metalworking, masonry, graphic arts, and cosmetology. School D also had several industrial arts courses.

The introduction of the cluster concept program into this school enabled those students enrolled in the general program to elect a course which would provide them with technical skills while not tracking them into the vocational program. School D offered two different cluster programs--the construction cluster taught by Teacher D (described in previous section) and the metal forming and fabrication cluster taught by Teacher F.

The administration. The school administration was one of the early supporters of the cluster concept idea during phase I. Teacher F received aid from the administration in resolving problems of enrollment and scheduling.

The county administration provided Teacher F with the majority of the tools, materials, and equipment needed for the metal forming and fabrication cluster that were not already on hand at the beginning of the year. The supervisor of industrial education met with members of the research team and with the principal investigator several times throughout the year to discuss and evaluate the cluster concept programs in his county.

The teacher. Teacher F had a B.S. degree with a major in vocational-industrial education. He had 8 years teaching experience in the area of general metals. His service in the army as an officer and trainer of newly assigned soldiers was valuable as was his five and one-half years work as a machinist.

Teacher F had very good rapport with his students and did a commendable job of initiating the cluster concept in his school. He followed the course outline closely and provided theoretical and practical instruction in all the occupations in the cluster. His laboratory was always in order and student activities always gave evidence of well planned and organized procedures.

Teacher F's contribution in the first year of the pilot program was a credit to the overall research effort connected with the metal forming and fabrication cluster.

Physical facilities. Sixteen boys were enrolled in the metal forming and fabrication cluster in School D. The facility was of sufficient size to accommodate the diverse activities called for in the curriculum. It was well equipped and contained about 90 percent of the items recommended for the program at the beginning of the school year. Several major pieces of equipment including a heli-arc welder, surface grinder , and two sheet metal shears were added during the year.

A detailed drawing of the laboratory in which the cluster program was conducted is shown at the end of this section. The drawing also indicates major pieces of equipment and shows their location in the laboratory. See Illustration 6.

Instruction. The students gained experience in all occupations of the cluster during the year. The pupils in Teacher F's class always appeared industrious and absorbed in their work. Activities were well organized and coordinated. Nearly all of the level I tasks were taught and activities appropriate to them were carried on.

Numerous useful projects were completed including spur gears, fireplace tool sets, adjustable squares, tool boxes and a metal table to hold the newly acquired sheet metal machines.

In order to evaluate the performance of each student enrolled in the metal forming and fabrication cluster a task inventory was developed. This inventory listed all the tasks to be taught in the metal forming and fabrication cluster. When kept up-to-date, it represented a record of student progress and achievement to teachers, parents, pupils and frequently, employers.

The task evaluation charts located at the end of this section are of two types. One list indicates the tasks which were to be taught in the cluster concept program. Those tasks taught this year are indicated by a check (✓). Those tasks which need to be retaught next year are indicated by a double check mark (✓✓). See Figure 24.

The second evaluation indicates, in the teacher's opinion, how each student in his class was able to perform the task. Each student received either a satisfactory (S) or unsatisfactory (U) as an evaluation of his achievement. Those tasks not taught during the first year of the pilot program were indicated by the letter (N). See Figure 25.

Community involvement. Several of Teacher F's students found summer employment in the community in one of the occupations included in the metal forming and fabrication cluster. A Spring conference was held which gave some local industries a chance to send representatives to the school in order to talk to vocational students about preparing for employment and employment opportunities. A display of cluster concept curriculum materials and projects was integrated with the conference.

A visual summary of the preceding five areas, administration, teacher, physical facilities, instruction, and community involvement, which have been featured in the description of the metal forming and fabrication cluster program at School D, is presented in Figure 26.

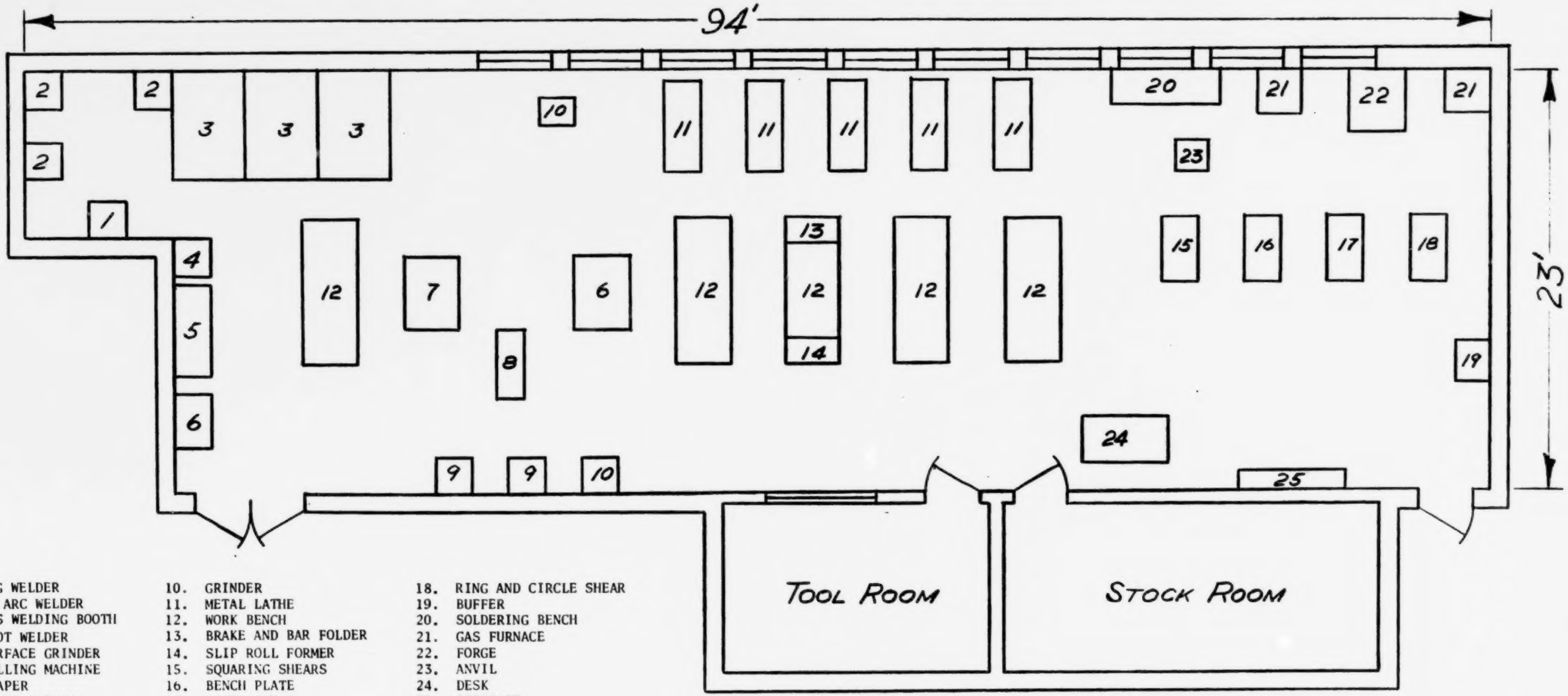
Summary and recommendations. The students in the metal forming and fabrication cluster at School D have had the benefit of a well equipped facility and the services of an experienced teacher. They received instructions in nearly all of the level I tasks in each of the occupations in the cluster together with the practical experience necessary for them to perform the task satisfactorily. See Figure 25.

The major shortcoming of the program during the first year of the pilot study would appear to be the absence of field trips. The community is rich in opportunity for such activities and they would appear beneficial to widen the horizons of the students and encourage them by revealing the opportunity which awaits the well trained high school graduate.

The addition of a DC welder and several sheet metal machines would add significantly to the program in the second year of the pilot study. It is recommended that this equipment be obtained no later than the beginning of the second semester of the 1968-1969 school year.

SCHOOL D

METAL FORMING & FABRICATION CLUSTER


94'
23'
2
2
2
3
3
3
1
4
5
6
10
11
11
11
11
11
20
21
22
21
23
12
7
6
12
13
12
14
12
12
15
16
17
18
19
8
24
9
9
10
25
TOOL ROOM
STOCK ROOM

1. TIG WELDER
2. AC ARC WELDER
3. GAS WELDING BOOTH
4. SPOT WELDER
5. SURFACE GRINDER
6. MILLING MACHINE
7. SHAPER
8. POWER HACKSAW
9. DRILL PRESS
10. GRINDER
11. METAL LATHE
12. WORK BENCH
13. BRAKE AND BAR FOLDER
14. SLIP ROLL FORMER
15. SQUARING SHEARS
16. BENCH PLATE
17. LEVEL SHEAR
18. RING AND CIRCLE SHEAR
19. BUFFER
20. SOLDERING BENCH
21. GAS FURNACE
22. FORGE
23. ANVIL
24. DESK
25. BOOKCASE

ILLUSTRATION 6

TASK EVALUATION CHART

MACHINING EXPERIENCES

Level	Task No.	Task Statement	
I	1	Turning stock on lathe to produce a faced surface.	✓
I	2	Countersinking (countersink and center drill) stock to produce a tapered hole for mounting stock between centers.	✓
I	3	Turning stock on lathe to produce a cyclindrical shape to .001 inch.	✓
I	4	Turning stock on lathe to produce a shoulder to .001 of an inch.	✓
I	5	Drilling stock on lathe to produce a hole to .005 of an inch.	✓
II	6	Reaming stock on lathe to produce a finished hole to .001 of an inch.	✓✓
II	7	Boring stock on lathe to produce an enlarged hole to .001 of an inch.	✓✓
II	8	Counterboring stock on lathe to produce a recessed hole to .005 of an inch.	✓✓
I	9	Parting stock on lathe to produce a piece within 1/32 of an inch.	✓
II	10	Necking stock on lathe to produce a necked shape to 1/32 of an inch.	
I	11	Filing stock on lathe to produce a finished surface.	✓
I	12	Machining stock on shaper to produce a flat surface.	✓
I	13	Machining stock on shaper to produce two parallel surfaces to .005 of an inch.	✓
I	14	Drilling stock on drill press to produce a hole to .005 of an inch.	✓
II	15	Reaming a hole on drill press to produce a finished hole to .001 of an inch.	✓✓
I	16	Spot facing a hole on drill press to produce a finished surface to .005 of an inch.	✓
I	17	Countersinking on drill press to produce a fastener receiver hole.	✓
II	18	Counterboring stock on drill press to produce an enlarged hole to .005 of an inch.	✓✓
I	19	Grinding stock on bench grinder to remove excess metal.	✓
I	20	Grinding drill bits on a bench grinder to sharpen tools.	✓

Level	Task No.	Task Statement	
I	21	Grinding stock on surface grinder to produce a flat surface.	✓✓
I	22	Grinding stock on surface grinder to produce two parallel surfaces to .001 of an inch.	✓✓
II	23	Grinding stock on surface grinder to produce two perpendicular surfaces to .001 of an inch.	✓✓
II	24	Grinding stock on surface grinder to produce an angular surface.	✓✓
I	25	Machining stock on a horizontal milling machine to produce a flat surface.	✓
I	26	Machining stock on a horizontal milling machine to produce parallel surfaces to .001 of an inch.	✓
II	27	Machining stock on a horizontal milling machine to produce two perpendicular surfaces to .001 of an inch.	
II	28	Machining stock on a horizontal milling machine to produce a shoulder to .001 of an inch.	
II	29	Machining stock on a horizontal milling machine to produce an angular surface.	
I	30	Machining stock on a vertical milling machine to produce a flat surface.	✓
I	31	Machining stock on a vertical milling machine to produce two parallel surfaces to .001 of an inch.	✓
II	32	Machining stock on vertical milling machine to produce two perpendicular surfaces to .001 of an inch.	
II	33	Machining stock on vertical milling machine to produce a shoulder to .001 of an inch.	
		WELDING EXPERIENCES	
		Arc welding ferrous metals with A.C. welder to produce:	
I	1	a horizontal butt joint.	✓
I	2	a horizontal lap joint.	✓
I	3	a horizontal outside corner joint.	✓
I	4	a horizontal inside corner joint.	✓
I	5	a horizontal tee joint.	✓
I	6	a vertical lap joint.	✓
II	7	Arc welding pipe stock with A.C. welder to produce a butt joint while fixed.	
II	8	Arc welding pipe stock with A.C. welder to produce butt joints while rolling.	

Figure 24.

Level	Task No.	Task Statement	
		Arc welding ferrous metals with D.C. welder to produce	
I	9	a horizontal butt joint.	
I	10	a horizontal lap joint.	
I	11	a horizontal outside corner joint.	
I	12	a horizontal inside corner joint.	
I	13	a horizontal tee joint.	
I	14	a vertical lap joint.	
II	15	Arc welding pipe stock with D.C. welder to produce butt joints while fixed.	
II	16	Arc welding pipe stock with D.C. welder to produce butt joints while rolling.	
I	17	Pad welding low areas on metal stock to renew stock to original height.	
		Gas welding ferrous metals stock to produce:	
I	18	a horizontal butt joint.	
I	19	a horizontal lap joint.	
I	20	a horizontal outside corner joint.	
I	21	a horizontal inside corner joint.	
I	22	a horizontal tee joint.	
I	23	a vertical lap joint.	
I	24	Gas cutting ferrous carbon steels.	✓
		Brazing ferrous metals to produce:	
I	25	a horizontal butt joint.	✓
I	26	a horizontal lap joint.	✓
I	27	a horizontal outside corner joint.	✓
I	28	a horizontal inside corner joint.	✓
I	29	a horizontal tee joint.	✓
I	30	a vertical lap joint.	✓
		Brazing non-ferrous metals to produce:	
II	31	a horizontal butt joint.	
II	32	a horizontal lap joint.	
II	33	a horizontal outside corner joint.	
II	34	a horizontal inside corner joint.	
II	35	a horizontal tee joint.	
II	36	a vertical lap joint.	
		Inert gas welding ferrous metals to produce:	
II	37	a horizontal butt joint.	
II	38	a horizontal lap joint.	
II	39	a horizontal outside corner joint.	
II	40	a horizontal inside corner joint.	
II	41	a horizontal tee joint.	
II	42	a vertical lap joint.	
II	43	Inert gas welding pipe stock to produce butt joints while rolling.	
II	44	Inert gas welding pipe stock to produce butt joints while fixed.	
		Inert gas welding non-ferrous metals to produce:	
II	45	a horizontal butt joint.	
II	46	a horizontal lap joint.	
II	47	a horizontal outside corner joint.	
II	48	a horizontal inside corner joint.	
II	49	a horizontal tee joint.	
II	50	a vertical lap joint.	
II	51	butt joints while rolling	
II	52	butt joints while fixed	
		SHEET METAL EXPERIENCES	
I	1	Tracing templates on sheet metal for cutting, bending and joining sheet metal items.	✓
I	2	Cutting sheet metal with hand tools to produce a straight cut within 1/32 of an inch.	✓
II	3	Cutting sheet metal with machinery to produce a straight cut within 1/32 of an inch.	
I	4	Cutting sheet metal with hand tools to produce a circular cut within 1/32 of an inch.	✓
II	5	Cutting sheet metal with machinery to produce a circular cut within 1/32 of an inch.	✓✓
I	6	Cutting sheet metal with hand tools to produce an irregular cut within 1/32 of an inch.	✓✓
II	7	Cutting sheet metal with machinery to produce an irregular cut within 1/32 of an inch.	✓✓
I	8	Cutting sheet metal with hand tools to produce a notched cut within 1/32 of an inch.	✓

Figure 24, continued

Level	Task No.	Task Statement	
II	9	Cutting sheet metal with machinery to produce a notched cut within 1/32 of an inch.	✓✓
I	10	Cutting sheet metal to produce an interior cut within 1/32 of an inch.	✓
II	11	Forming sheet metal cylindrical shapes on slip roll forming machine.	✓
I	12	Forming sheet metal crimping on a crimping machine.	✓
I	13	Forming sheet metal beading on a beading machine.	
II	14	Forming single hem on bar folder or brake for strength.	
II	15	Forming double hem on bar folder or brake for strength.	
II	16	Forming single seam on a brake and/or bar folder for joining sheet metal parts.	
II	17	Forming double seam on a brake and/or bar folder for joining sheet metal parts.	
II	18	Forming Pittsburgh lock seam with machinery for joining sheet metal parts.	
II	19	Forming cap strip seam on a drive cap machine for joining sheet metal parts.	
I	20	Drilling sheet metal to produce a fastener receiver hole.	✓
II	21	Adhering sheet metal parts with adhesives to produce an assembly.	
II	22	Welding (spot) sheet metal parts to produce an assembly.	✓
II	23	Soldering sheet metal parts to produce an assembly.	✓
I	24	Fastening sheet metal parts with sheet metal screws to produce an assembly.	✓
[illegible]	25	Bolting sheet metal parts to produce an assembly.	✓
II	26	Riveting sheet metal parts to produce an assembly.	✓
[illegible]	27	Joining sheet metal parts with seams.	✓
		ASSEMBLY EXPERIENCES	
[illegible]	1	Adhering parts with adhesives using hand processes to produce a metal bonded assembly	✓
II	2	Adhering parts with adhesives using spray equipment to a specified thickness to produce a metal bonded assembly.	

Level	Task No.	Task Statement	
I	3	Fastening metal parts with screws to produce an assembly.	✓
I	4	Bolting metal parts with screws to produce an assembly.	✓
I	5	Riveting metal parts to produce an assembly.	✓
I	6	Tightening metal fasteners with hand power tools.	
II	7	Mating parts together to produce sub-assemblies.	
II	8	Mating parts and sub-assemblies together to produce major assemblies.	
I	9	Holding parts in clamping devices for assembly of details, sub-assemblies and assemblies.	✓
II	10	Cutting materials with hand tools to fit in an assembly.	✓
II	11	Cutting materials with power tools to fit in an assembly to 1/32 of an inch.	✓✓
I	12	Filing stock to produce a finished assembly to .001 of an inch.	✓
I	13	Drilling holes in material with hand drill to produce a hole to .005 of an inch.	✓
I	14	Drilling holes with a hand power drill to produce a hole to .005 of an inch.	✓
II	15	Reaming stock with hand wrench to produce a finished hole to .001 of an inch.	
II	16	Reaming stock with power drill to produce a finished hole to .001 of an inch.	
I	17	Countersinking holes with hand tools to produce a fastener receiver hole.	✓
I	18	Countersinking holes with power drill to produce a fastener receiver hole.	✓
II	19	Tapping holes with taps to produce a threaded hole.	✓✓
II	20	Cutting threads with dies to produce a threaded member.	✓✓
II	21	Punching materials with hand punches to produce a hole.	✓
II	22	Punching materials with power tools to produce an assembly.	✓

Figure 24, continued

Level	Task No.	Task Statement	
I	23	Checking dimensions of details with precision instruments for accurate assembly.	✓
I	24	Checking dimensions of sub-assemblies and assemblies to produce accurate assemblies.	✓
II	25	Measuring stock with precision instruments for assembly.	✓
I	26	Stamping number and letters on metal stock for identification.	✓
I	27	Hammering appropriate metal parts with various hammers.	✓
II	28	Flaring metal tubing with a flaring tool to produce a flare.	☐
II	29	Aligning parts in sub-assemblies and assemblies with hand tools.	☐

Figure 24, continued

TASK EVALUATION CHART

MACHINING EXPERIENCES

Level	Task No.	Task Statement	Student																					
			A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V
I	1	Turning stock on lathe to produce a faced surface.	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S							
I	2	Countersinking (countersink and center drill) stock to produce a tapered hole for mounting stock between centers.	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S							
I	3	Turning stock on lathe to produce a cyclindrical shape to .001 inch.	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S							
I	4	Turning stock on lathe to produce a shoulder to .001 of an inch.	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S							
I	5	Drilling stock on lathe to produce a hole to .005 of an inch.	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S							
II	6	Reaming stock on lathe to produce a finished hole to .001 of an inch.	U	S	S	S	S	U	S	S	S	S	S	S	S	S	S							
II	7	Boring stock on lathe to produce an enlarged hole to .001 of an inch.	U	S	S	S	S	U	S	U	S	S	S	S	S	S	S							
II	8	Counterboring stock on lathe to produce a recessed hole to .005 of an inch.	U	S	S	S	S	U	S	S	S	S	S	U	S	S	S							
I	9	Parting stock on lathe to produce a piece within 1/32 of an inch.	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S							
II	10	Necking stock on lathe to produce a necked shape to 1/32 of an inch.	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N							
I	11	Filing stock on lathe to produce a finished surface.	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S							
I	12	Machining stock on shaper to produce a flat surface.	S	S	S	S	S	U	S	S	S	S	S	S	S	S	S							
I	13	Machining stock on shaper to produce two parallel surfaces to .005 of an inch.	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S							
I	14	Drilling stock on drill press to produce a hole to .005 of an inch.	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S							
II	15	Reaming a hole on drill press to produce a finished hole to .001 of an inch.	U	S	S	S	S	U	S	U	S	S	S	U	S	S	S							
I	16	Spot facing a hole on drill press to produce a finished surface to .005 of an inch.	S	S	S	S	S	U	S	S	S	S	S	S	S	S	S							
I	17	Countersinking on drill press to produce a fastener receiver hole.	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S							
II	18	Counterboring stock on drill press to produce an enlarged hole to .005 of an inch.	U	S	S	S	S	U	S	U	S	S	S	S	S	S	S							
I	19	Grinding stock on bench grinder to remove excess metal.	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S							
I	20	Grinding drill bits on a bench grinder to sharpen tools.	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S							

Figure 25

			Student																					
Level	Task No.	Task Statement	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V
I	21	Grinding stock on surface grinder to produce a flat surface.	U	S	S	S	S	S	S	U	S	S	S	S	S	S	S							
I	22	Grinding stock on surface grinder to produce two parallel surfaces to .001 of an inch.	U	S	S	S	S	S	S	U	S	S	S	S	S	S	S							
II	23	Grinding stock on surface grinder to produce two perpendicular surfaces to .001 of an inch.	U	S	S	S	S	U	S	U	S	S	S	S	S	S	S							
II	24	Grinding stock on surface grinder to produce an angular surface.	U	S	S	S	S	U	S	U	S	S	S	S	S	S	S							
I	25	Machining stock on a horizontal milling machine to produce a flat surface.	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S							
I	26	Machining stock on a horizontal milling machine to produce parallel surfaces to .001 of an inch.	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S							
II	27	Machining stock on a horizontal milling machine to produce two perpendicular surfaces to .001 of an inch.	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N							
II	28	Machining stock on a horizontal milling machine to produce a shoulder to .001 of an inch.	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N							
II	29	Machining stock on a horizontal milling machine to produce an angular surface.	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N							
I	30	Machining stock on a vertical milling machine to produce a flat surface.	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S							
I	31	Machining stock on a vertical milling machine to produce two parallel surfaces to .001 of an inch.	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S							
II	32	Machining stock on vertical milling machine to produce two perpendicular surfaces to .001 of an inch.	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N							
II	33	Machining stock on vertical milling machine to produce a shoulder to .001 of an inch.	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N							
		WELDING EXPERIENCES																						
		Arc welding ferrous metals with A.C. welder to produce:																						
I	1	a horizontal butt joint.	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S							
I	2	a horizontal lap joint.	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S							
I	3	a horizontal outside corner joint.	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S							
I	4	a horizontal inside corner joint.	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S							
I	5	a horizontal tee joint.	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S							
I	6	a vertical lap joint.	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S							
II	7	Arc welding pipe stock with A.C. welder to produce a butt joint while fixed.	U	U	S	S	S	U	S	U	S	S	U	U	U	U	S							
II	8	Arc welding pipe stock with A.C. welder to produce butt joints while rolling.	U	U	S	S	S	U	S	U	S	S	U	U	U	U	U							

Figure 25, continued

Level	Task No.	Task Statement	Student																					
			A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V
		Arc welding ferrous metals with D.C. welder to produce																						
I	9	a horizontal butt joint.	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N							
I	10	a horizontal lap joint.	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N							
I	11	a horizontal outside corner joint.	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N							
I	12	a horizontal inside corner joint.	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N							
I	13	a horizontal tee joint.	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N							
I	14	a vertical lap joint.	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N							
II	15	Arc welding pipe stock with D.C. welder to produce butt joints while fixed.	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N							
II	16	Arc welding pipe stock with D.C. welder to produce butt joints while rolling.	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N							
I	17	Pad welding low areas on metal stock to renew stock to original height.	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N							
		Gas welding ferrous metals stock to produce:																						
I	18	a horizontal butt joint.	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N							
I	19	a horizontal lap joint.	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N							
I	20	a horizontal outside corner joint.	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N							
I	21	a horizontal inside corner joint.	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N							
I	22	a horizontal tee joint.	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N							
I	23	a vertical lap joint.	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N							
I	24	Gas cutting ferrous carbon steels.	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S							
		Brazing ferrous metals to produce:																						
I	25	a horizontal butt joint.	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S							
I	26	a horizontal lap joint.	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S							
I	27	a horizontal outside corner joint.	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S							
I	28	a horizontal inside corner joint.	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S							
I	29	a horizontal tee joint.	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S							
I	30	a vertical lap joint.	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S							
		Brazing non-ferrous metals to produce:																						
II	31	a horizontal butt joint.	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N							
II	32	a horizontal lap joint.	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N							
II	33	a horizontal outside corner joint.	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N							
II	34	a horizontal inside corner joint.	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N							
II	35	a horizontal tee joint.	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N							
II	36	a vertical lap joint.	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N							

Figure 25, continued

			Student																					
Level	Task No.	Task Statement	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V
		Inert gas welding ferrous metals to produce:																						
II	37	a horizontal butt joint.	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N							
II	38	a horizontal lap joint.	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N							
II	39	a horizontal outside corner joint.	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N							
II	40	a horizontal inside corner joint.	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N							
II	41	a horizontal tee joint.	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N							
II	42	a vertical lap joint.	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N							
II	43	Inert gas welding pipe stock to produce butt joints while rolling.	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N							
II	44	Inert gas welding pipe stock to produce butt joints while fixed.	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N							
		Inert gas welding non-ferrous metals to produce:																						
II	45	a horizontal butt joint.	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N							
II	46	a horizontal lap joint.	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N							
II	47	a horizontal outside corner joint.	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N							
II	48	a horizontal inside corner joint.	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N							
II	49	a horizontal tee joint.	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N							
II	50	a vertical lap joint.	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N							
II	51	butt joints while rolling	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N							
II	52	butt joints while fixed	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N							
		SHEET METAL EXPERIENCES																						
I	1	Tracing templates on sheet metal for cutting, bending and joining sheet metal items.	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S							
I	2	Cutting sheet metal with hand tools to produce a straight cut within 1/32 of an inch.	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S							
II	3	Cutting sheet metal with machinery to produce a straight cut within 1/32 of an inch.	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N							
I	4	Cutting sheet metal with hand tools to produce a circular cut within 1/32 of an inch.	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S							
II	5	Cutting sheet metal with machinery to produce a circular cut within 1/32 of an inch.	U	S	U	S	U	S	S	U	S	S	U	U	S	S	S							
I	6	Cutting sheet metal with hand tools to produce an irregular cut within 1/32 of an inch.	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S							
II	7	Cutting sheet metal with machinery to produce an irregular cut within 1/32 of an inch.	S	U	S	S	S	U	U	U	S	U	U	S	S	S	S							
I	8	Cutting sheet metal with hand tools to produce a notched cut within 1/32 of an inch.	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S							

Figure 25, continued

			Student																					
Level	Task No.	Task Statement	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V
II	9	Cutting sheet metal with machinery to produce a notched cut within 1/32 of an inch.	S	U	S	S	S	U	U	U	S	U	U	S	S	S	S							
I	10	Cutting sheet metal to produce an interior cut within 1/32 of an inch.	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S							
II	11	Forming sheet metal cylindrical shapes on slip roll forming machine.	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S							
I	12	Forming sheet metal crimping on a crimping machine.	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S							
I	13	Forming sheet metal beading on a beading machine.	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S							
II	14	Forming single hem on bar folder or brake for strength.	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N							
II	15	Forming double hem on bar folder or brake for strength.	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N							
II	16	Forming single seam on a brake and/or bar folder for joining sheet metal parts.	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N							
II	17	Forming double seam on a brake and/or bar folder for joining sheet metal parts.	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N							
II	18	Forming Pittsburgh lock seam with machinery for joining sheet metal parts.	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N							
II	19	Forming cap strip seam on a drive cap machine for joining sheet metal parts.	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S							
I	20	Drilling sheet metal to produce a fastener receiver hole.	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S							
II	21	Adhering sheet metal parts with adhesives to produce an assembly.	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N							
II	22	Welding (spot) sheet metal parts to produce an assembly.	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S							
II	23	Soldering sheet metal parts to produce an assembly.	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S							
I	24	Fastening sheet metal parts with sheet metal screws to produce an assembly.	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S							
I	25	Bolting sheet metal parts to produce an assembly.	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S							
II	26	Riveting sheet metal parts to produce an assembly.	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S							
I	27	Joining sheet metal parts with seams.	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S							
		ASSEMBLY EXPERIENCES																						
I	1	Adhering parts with adhesives using hand processes to produce a metal bonded assembly	S	U	S	S	S	S	S	S	S	U	S	S	S	S	S							
II	2	Adhering parts with adhesives using spray equipment to a specified thickness to produce a metal bonded assembly.	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N							

Figure 25, continued

Student

Level	Task No.	Task Statement	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V
I	3	Fastening metal parts with screws to produce an assembly.	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S							
I	4	Bolting metal parts with screws to produce an assembly.	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S							
I	5	Riveting metal parts to produce an assembly.	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S							
I	6	Tightening metal fasteners with hand power tools.	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N							
II	7	Mating parts together to produce sub-assemblies.	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N							
II	8	Mating parts and sub-assemblies together to produce major assemblies.	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N							
I	9	Holding parts in clamping devices for assembly of details, sub-assemblies and assemblies.	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S							
II	10	Cutting materials with hand tools to fit in an assembly.	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S							
II	11	Cutting materials with power tools to fit in an assembly to 1/32 of an inch.	U	U	S	S	S	S	S	S	S	S	S	S	S	S	S							
I	12	Filing stock to produce a finished assembly to .001 of an inch.	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S							
I	13	Drilling holes in material with hand drill to produce a hole to .005 of an inch.	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S							
I	14	Drilling holes with a hand power drill to produce a hole to .005 of an inch.	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S							
II	15	Reaming stock with hand wrench to produce a finished hole to .001 of an inch.	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N							
II	16	Reaming stock with power drill to produce a finished hole to .001 of an inch.	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N							
I	17	Countersinking holes with hand tools to produce a fastener receiver hole.	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S							
I	18	Countersinking holes with power drill to produce a fastener receiver hole.	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S							
II	19	Tapping holes with taps to produce a threaded hole.	U	U	S	S	S	U	U	U	S	U	U	S	S	S	S							
II	20	Cutting threads with dies to produce a threaded member.	S	U	S	S	S	U	S	S	S	S	S	S	S	U	U							
II	21	Punching materials with hand punches to produce a hole.	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S							
II	22	Punching materials with power tools to produce an assembly.	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S							

Figure 25, continued

Level	Task No.	Task Statement	Student																					
			A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V
I	23	Checking dimensions of details with precision instruments for accurate assembly.	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S							
I	24	Checking dimensions of sub-assemblies and assemblies to produce accurate assemblies.	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S							
II	25	Measuring stock with precision instruments for assembly.	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S							
I	26	Stamping number and letters on metal stock for identification.	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S							
I	27	Hammering appropriate metal parts with various hammers.	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S							
II	28	Flaring metal tubing with a flaring tool to produce a flare.	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N							
II	29	Aligning parts in sub-assemblies and assemblies with hand tools.	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N							

Figure 25, continued

SUMMARY-EVALUATION OF CLUSTER CONCEPT PILOT PROGRAM

SCHOOL D - TEACHER F

	1	2	3	4	5
ADMINISTRATION	The school and county administrative personnel provided minimal moral and material support to the program and the teacher.		The school and county administrative personnel actively supported the program by furnishing the teacher with moral support but with less than satisfactory material support.		The school and county administrative personnel actively supported the program by furnishing the teacher with adequate moral and material support.
TEACHER	Little academic preparation in major field. Little or no teaching experience or practical experience in major field. Seldom shows resourcefulness or initiative.		Adequate academic preparation in major field. Has some teaching experience and some practical experience in major field. Sometime shows resourcefulness and initiative.		Superior academic preparation in major field. An experienced teacher with practical experience in major field. Resourceful. An initiator.
PHYSICAL FACILITIES	The size of the laboratory is inadequate and severely restricts occupational activities. The program also suffers from lack of equipment.		The size of the laboratory is adequate but somewhat restricts occupational activities. The laboratory has the minimum amount of equipment for operating the cluster program.		Size of the laboratory allows unrestricted occupational activities. The laboratory is suitably equipped for the cluster program.
INSTRUCTION	Tasks were taught in only one or two occupations. A very restricted number of Level I tasks were performed by the students. Few experiences offered were appropriate to the cluster.		Tasks were taught in several occupations. A majority of Level I tasks were performed by the students. Experiences were not always appropriate to occupations in the cluster.		Tasks were taught in all occupations. Most Level I tasks were performed by the students. Student experiences were extremely appropriate to occupations in the cluster.
COMMUNITY INVOLVEMENT	Community organizations were unaware of, or did not support the cluster program. Little opportunity for employment was evident in the community.		Community organizations furnished some support to the cluster program. Some members of the class found employment opportunity in the community.		Community organizations cooperated by furnishing aid to the program. A large proportion of the class found employment opportunity in the community.

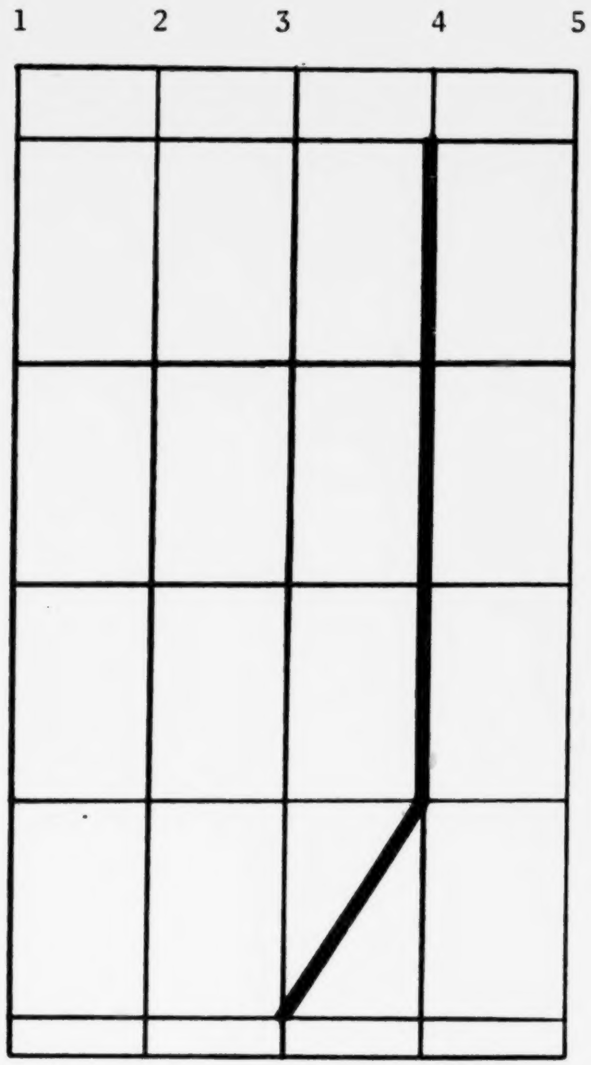


Figure 26.

Orientation. School E was located in an urban setting. Students in grades 10 through 12 were in attendance. The students could select either the college entrance, business, vocational, or general curriculum.

The introduction of the metal forming and fabrication cluster into this school added another dimension to the practical arts curriculum. In addition to the cluster program, the other practical areas of the curriculum included courses in home economics, business subjects, graphic arts, design-drafting and illustration technology, diversified occupations, and industrial arts.

The administration. The administration of School E gave substantial support to the cluster concept program and to the teacher. The principal and the guidance counselor were especially cooperative in remedying scheduling problems which occurred during the first few weeks of the pilot program.

The county administration also supported the program. Several major pieces of equipment were obtained to supplement those already on hand.

The industrial education supervisor visited the schools in the county with the project director and principal investigator as well as being on hand for scheduled visits of the research assistants.

The teacher. Teacher E had a B.S. degree with a major in History and had attended a year of graduate school to become certified in Industrial Education. He had three years teaching experience at the senior high school level.

Teacher E's armed forces experience in aircraft riveting, welding, and sheet metal layout was particularly applicable to the metal forming and fabrication cluster as was his summer work experience with Pratt and Whitney Aircraft Company.

Teacher E's class was always well organized and engaged in purposeful activities. He was found to be very thorough in teaching the level I tasks except where restricted by a lack of equipment.

Physical facilities. Eighteen boys were enrolled in the metal forming and fabrication cluster at School E. The size of the laboratory was rather restrictive of activities. The facility was quite well equipped and several new pieces of equipment were added during the year. By conducting a survey it was found that considerable amounts of tools, materials, and equipment still need to be added to bring the inventory up to the level recommended.

A detailed drawing of the laboratory in which the cluster program was conducted is shown at the end of this section. This drawing also indicates major pieces of equipment and shows their location in the laboratory. See Illustration 7.

Instruction. The students obtained a broad experience in the metal forming and fabrication cluster through satisfactory performance of tasks in all the occupations of the cluster. Several large projects were constructed which integrated experiences from each of the major areas in the cluster. Two examples of this type of project were a snow blower and a utility trailer. Several types of practice pieces were utilized as were numerous smaller projects which were central to the practical part of the instruction.

In order to evaluate the performance of each student enrolled in the metal forming and fabrication cluster a task inventory was developed. This inventory listed all the tasks to be taught in the metal forming and fabrication cluster. When kept up-to-date, it represented a record of student progress and achievement to teachers, parents, pupils, and frequently, employers.

The task evaluation charts located at the end of this section are of two types. One list indicates the tasks which were to be taught in the cluster concept program. Those tasks taught this year are indicated by a check (✓). Those tasks which need to be retaught next year are indicated by a double check mark (✓✓). See Figure 27.

The second evaluation chart indicates, in the teacher's opinion, how each student in his class was able to perform the task. Each student received either a satisfactory (S) or unsatisfactory (U) as an evaluation of his achievement. Those tasks not taught during the first year of the pilot program were indicated by the letter (N). See Figure 28.

Community involvement. Approximately half of the class obtained summer employment in one of the occupations in the metal forming and fabrication cluster. The class participated in an exhibition of work at the Montgomery County Education Exhibit.

A visual summary of the preceding five areas, administration, teacher, physical facilities, instruction, and community involvement, which have been featured in the description of the pilot program at School E is presented in Figure 29.

Summary and recommendations. The students in the metal forming and fabrication cluster at School E completed nearly all the level I tasks in each occupation. It was not possible to complete all of them due to a lack of equipment. An excellent job of presenting theoretical information and practical experience was accomplished by Teacher E.

Although the facility was small for the activities engaged in, there does not appear to be any solution to this problem in School E.

The program could be significantly improved during the second year of the pilot program through the addition of the balance of the recommended tools, materials, and equipment.

Student experiences could be broadened through the use of field trips to selected industries in the community of which there is an ample number.

A more comprehensive record keeping system would be of assistance to the research effort. Although this has not been a serious drawback, the effort of Teacher E in this category could be improved.

SCHOOL E

METAL FORMING & FABRICATION CLUSTER

1. OXY-ACETYLENE WELDING AND SOLDERING
2. SINK
3. COMPRESSOR
4. FOUNDRY BENCH
5. DRILL PRESS
6. METAL LATHE
7. WORK BENCH
8. SURFACE GRINDER
9. SANDER
10. GRINDER
11. VERTICAL MILLING MACHINE
12. HACK SAW
13. HORIZONTAL MILLING MACHINE
14. BRAKE AND CIRCLE SHEARS
15. SQUARING SHEARS
16. ANVIL
17. SLIP ROLL FORMER AND BENCH PLATE
18. BAR FOLDER AND DOUBLE SEAMER
19. LAPIDARY EQUIPMENT
20. BUFFER
21. GAS FURNACE AND FORGE
22. ARC WELDER
23. BRAKE

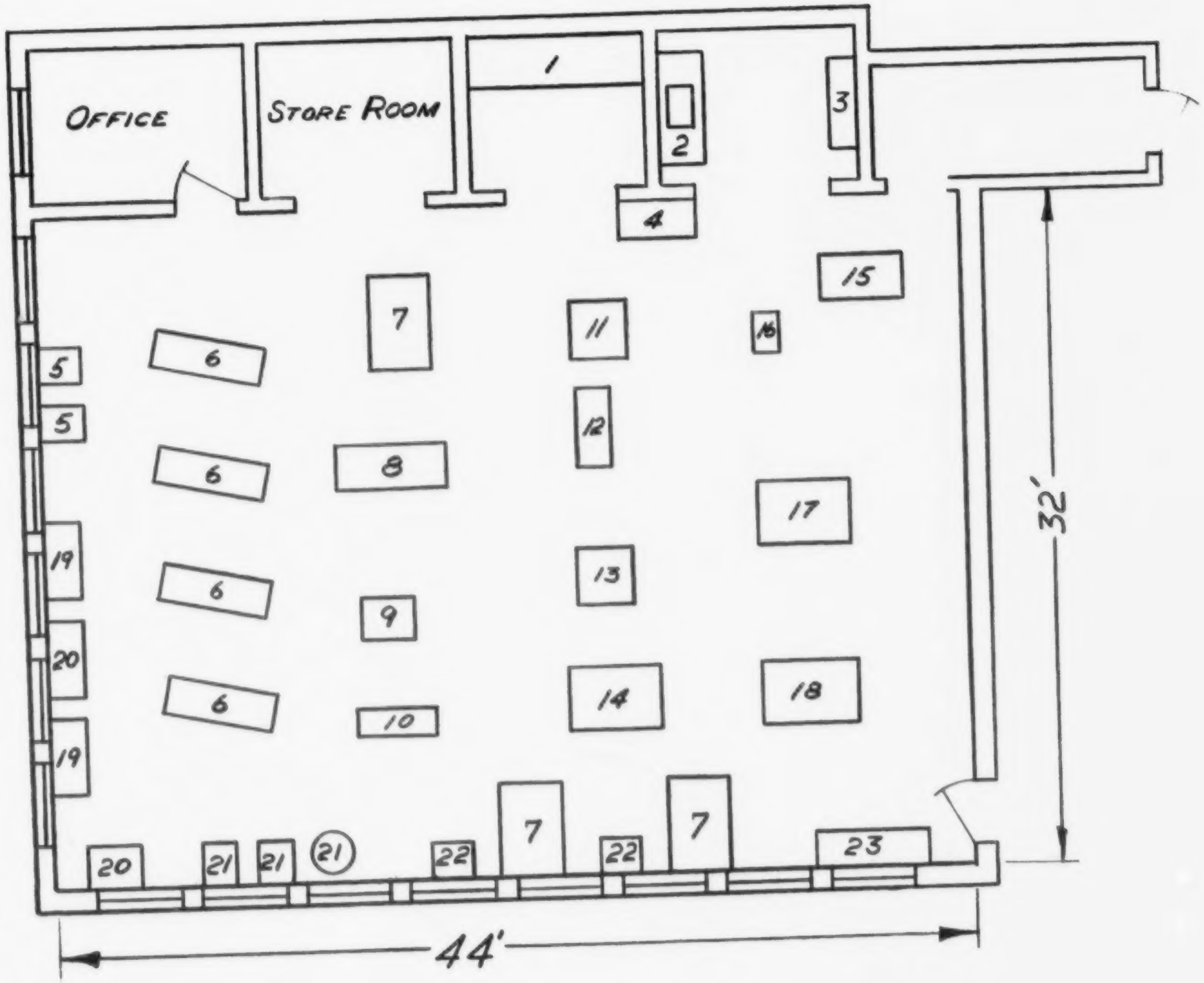

OFFICE
STORE ROOM
1
2
3
4
5
5
6
6
6
6
7
7
7
8
9
10
11
12
13
14
15
16
17
18
19
20
19
20
21
21
21
22
22
23
32'
44'

ILLUSTRATION 7

TASK EVALUATION CHART

MACHINING EXPERIENCES

Level	Task No.	Task Statement	
I	1	Turning stock on lathe to produce a faced surface.	✓
I	2	Countersinking (countersink and center drill) stock to produce a tapered hole for mounting stock between centers.	✓✓
I	3	Turning stock on lathe to produce a cyclindrical shape to .001 inch.	✓✓
I	4	Turning stock on lathe to produce a shoulder to .001 of an inch.	✓✓
I	5	Drilling stock on lathe to produce a hole to .005 of an inch.	✓✓
II	6	Reaming stock on lathe to produce a finished hole to .001 of an inch.	✓✓
II	7	Boring stock on lathe to produce an enlarged hole to .001 of an inch.	✓✓
II	8	Counterboring stock on lathe to produce a recessed hole to .005 of an inch.	
I	9	Parting stock on lathe to produce a piece within 1/32 of an inch.	
II	10	Necking stock on lathe to produce a necked shape to 1/32 of an inch.	
I	11	Filing stock on lathe to produce a finished surface.	✓
I	12	Machining stock on shaper to produce a flat surface.	
I	13	Machining stock on shaper to produce two parallel surfaces to .005 of an inch.	
I	14	Drilling stock on drill press to produce a hole to .005 of an inch.	✓
II	15	Reaming a hole on drill press to produce a finished hole to .001 of an inch.	✓
I	16	Spot facing a hole on drill press to produce a finished surface to .005 of an inch.	
I	17	Countersinking on drill press to produce a fastener receiver hole.	✓
II	18	Counterboring stock on drill press to produce an enlarged hole to .005 of an inch.	✓
I	19	Grinding stock on bench grinder to remove excess metal.	✓
I	20	Grinding drill bits on a bench grinder to sharpen tools.	
I	21	Grinding stock on surface grinder to produce a flat surface.	✓
I	22	Grinding stock on surface grinder to produce two parallel surfaces to .001 of an inch.	✓✓
II	23	Grinding stock on surface grinder to produce two perpendicular surfaces to .001 of an inch.	✓✓
II	24	Grinding stock on surface grinder to produce an angular surface.	✓
I	25	Machining stock on a horizontal milling machine to produce a flat surface.	✓
I	26	Machining stock on a horizontal milling machine to produce parallel surfaces to .001 of an inch.	✓✓
II	27	Machining stock on a horizontal milling machine to produce two perpendicular surfaces to .001 of an inch.	✓✓
II	28	Machining stock on a horizontal milling machine to produce a shoulder to .001 of an inch.	✓✓
II	29	Machining stock on a horizontal milling machine to produce an angular surface.	✓
I	30	Machining stock on a vertical milling machine to produce a flat surface.	✓
I	31	Machining stock on a vertical milling machine to produce two parallel surfaces to .001 of an inch.	✓
II	32	Machining stock on vertical milling machine to produce two perpendicular surfaces to .001 of an inch.	✓
II	33	Machining stock on vertical milling machine to produce a shoulder to .001 of an inch.	✓✓
		WELDING EXPERIENCES	
		Arc welding ferrous metals with A.C. welder to produce:	
I	1	a horizontal butt joint.	✓
I	2	a horizontal lap joint.	✓
I	3	a horizontal outside corner joint.	✓
I	4	a horizontal inside corner joint.	✓
I	5	a horizontal tee joint.	✓
I	6	a vertical lap joint.	✓
II	7	Arc welding pipe stock with A.C. welder to produce a butt joint while fixed.	
II	8	Arc welding pipe stock with A.C. welder to produce butt joints while rolling.	

Figure 26.

Level	Task No.	Task Statement	
		Arc welding ferrous metals with D.C. welder to produce	☐
I	9	a horizontal butt joint.	☐
I	10	a horizontal lap joint.	☐
I	11	a horizontal outside corner joint.	☐
I	12	a horizontal inside corner joint.	☐
I	13	a horizontal tee joint.	☐
I	14	a vertical lap joint.	☐
II	15	Arc welding pipe stock with D.C. welder to produce butt joints while fixed.	☐
II	16	Arc welding pipe stock with D.C. welder to produce butt joints while rolling.	☐
I	17	Pad welding low areas on metal stock to renew stock to original height.	☐
		Gas welding ferrous metals stock to produce:	
I	18	a horizontal butt joint.	✓
I	19	a horizontal lap joint.	✓
I	20	a horizontal outside corner joint.	✓
I	21	a horizontal inside corner joint.	✓
I	22	a horizontal tee joint.	✓
I	23	a vertical lap joint.	✓
I	24	Gas cutting ferrous carbon steels.	✓
		Brazing ferrous metals to produce:	
I	25	a horizontal butt joint.	✓
I	26	a horizontal lap joint.	✓
I	27	a horizontal outside corner joint.	✓
I	28	a horizontal inside corner joint.	✓
I	29	a horizontal tee joint.	✓
I	30	a vertical lap joint.	✓
		Brazing non-ferrous metals to produce:	
II	31	a horizontal butt joint.	✓
II	32	a horizontal lap joint.	✓
II	33	a horizontal outside corner joint.	✓
II	34	a horizontal inside corner joint.	✓
II	35	a horizontal tee joint.	✓
II	36	a vertical lap joint.	✓

Level	Task No.	Task Statement	
		Inert gas welding ferrous metals to produce:	
II	37	a horizontal butt joint.	☐
II	38	a horizontal lap joint.	☐
II	39	a horizontal outside corner joint.	☐
II	40	a horizontal inside corner joint.	☐
II	41	a horizontal tee joint.	☐
II	42	a vertical lap joint.	☐
II	43	Inert gas welding pipe stock to produce butt joints while rolling.	☐
II	44	Inert gas welding pipe stock to produce butt joints while fixed.	☐
		Inert gas welding non-ferrous metals to produce:	
II	45	a horizontal butt joint.	☐
II	46	a horizontal lap joint.	☐
II	47	a horizontal outside corner joint.	☐
II	48	a horizontal inside corner joint.	☐
II	49	a horizontal tee joint.	☐
II	50	a vertical lap joint.	☐
II	51	butt joints while rolling	☐
II	52	butt joints while fixed	☐
		SHEET METAL EXPERIENCES	
I	1	Tracing templates on sheet metal for cutting, bending and joining sheet metal items.	✓
I	2	Cutting sheet metal with hand tools to produce a straight cut within 1/32 of an inch.	✓
II	3	Cutting sheet metal with machinery to produce a straight cut within 1/32 of an inch.	✓
I	4	Cutting sheet metal with hand tools to produce a circular cut within 1/32 of an inch.	✓
II	5	Cutting sheet metal with machinery to produce a circular cut within 1/32 of an inch.	✓
I	6	Cutting sheet metal with hand tools to produce an irregular cut within 1/32 of an inch.	✓
II	7	Cutting sheet metal with machinery to produce an irregular cut within 1/32 of an inch.	✓
I	8	Cutting sheet metal with hand tools to produce a notched cut within 1/32 of an inch.	✓

Figure 27, continued

Level	Task No.	Task Statement	
II	9	Cutting sheet metal with machinery to produce a notched cut within 1/32 of an inch.	✓
I	10	Cutting sheet metal to produce an interior cut within 1/32 of an inch.	✓
II	11	Forming sheet metal cylindrical shapes on slip roll forming machine.	✓
I	12	Forming sheet metal crimping on a crimping machine.	
I	13	Forming sheet metal beading on a beading machine.	✓
II	14	Forming single hem on bar folder or brake for strength.	✓
II	15	Forming double hem on bar folder or brake for strength.	✓
II	16	Forming single seam on a brake and/or bar folder for joining sheet metal parts.	✓
II	17	Forming double seam on a brake and/or bar folder for joining sheet metal parts.	✓
II	18	Forming Pittsburgh lock seam with machinery for joining sheet metal parts.	✓
II	19	Forming cap strip seam on a drive cap machine for joining sheet metal parts.	✓
I	20	Drilling sheet metal to produce a fastener receiver hole.	✓
II	21	Adhering sheet metal parts with adhesives to produce an assembly.	✓
II	22	Welding (spot) sheet metal parts to produce an assembly.	✓
II	23	Soldering sheet metal parts to produce an assembly.	✓
I	24	Fastening sheet metal parts with sheet metal screws to produce an assembly.	✓
I	25	Bolting sheet metal parts to produce an assembly.	✓
II	26	Riveting sheet metal parts to produce an assembly.	✓
I	27	Joining sheet metal parts with seams.	✓
		ASSEMBLY EXPERIENCES	
I	1	Adhering parts with adhesives using hand processes to produce a metal bonded assembly	✓
II	2	Adhering parts with adhesives using spray equipment to a specified thickness to produce a metal bonded assembly.	

Level	Task No.	Task Statement	
I	3	Fastening metal parts with screws to produce an assembly.	✓
I	4	Bolting metal parts with screws to produce an assembly.	✓
I	5	Riveting metal parts to produce an assembly.	✓
I	6	Tightening metal fasteners with hand power tools.	
II	7	Mating parts together to produce sub-assemblies.	✓
II	8	Mating parts and sub-assemblies together to produce major assemblies.	✓
I	9	Holding parts in clamping devices for assembly of details, sub-assemblies and assemblies.	✓
II	10	Cutting materials with hand tools to fit in an assembly.	✓
II	11	Cutting materials with power tools to fit in an assembly to 1/32 of an inch.	✓
I	12	Filing stock to produce a finished assembly to .001 of an inch.	✓
I	13	Drilling holes in material with hand drill to produce a hole to .005 of an inch.	✓
I	14	Drilling holes with a hand power drill to produce a hole to .005 of an inch.	✓
II	15	Reaming stock with hand wrench to produce a finished hole to .001 of an inch.	✓
II	16	Reaming stock with power drill to produce a finished hole to .001 of an inch.	✓
I	17	Countersinking holes with hand tools to produce a fastener receiver hole.	✓
I	18	Countersinking holes with power drill to produce a fastener receiver hole.	✓
II	19	Tapping holes with taps to produce a threaded hole.	✓
II	20	Cutting threads with dies to produce a threaded member.	✓
II	21	Punching materials with hand punches to produce a hole.	
II	22	Punching materials with power tools to produce an assembly.	

Figure 27, continued

Level	Task No.	Task Statement	
I	23	Checking dimensions of details with precision instruments for accurate assembly.	✓
I	24	Checking dimensions of sub-assemblies and assemblies to produce accurate assemblies.	✓
II	25	Measuring stock with precision instruments for assembly.	✓
I	26	Stamping number and letters on metal stock for identification.	✓
I	27	Hammering appropriate metal parts with various hammers.	✓
II	28	Flaring metal tubing with a flaring tool to produce a flare.	
II	29	Aligning parts in sub-assemblies and assemblies with hand tools.	✓

Figure 27, continued

TASK EVALUATION CHART

MACHINING EXPERIENCES

Level	Task No.	Task Statement	Student A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V
I	1	Turning stock on lathe to produce a faced surface.	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	
I	2	Countersinking (countersink and center drill) stock to produce a tapered hole for mounting stock between centers.	S	S	S	S	U	U	U	S	S	S	S	S	S	S	U	S	S	U	S	S	S	
I	3	Turning stock on lathe to produce a cyclindrical shape to .001 inch.	S	U	S	S	U	U	S	U	U	S	S	S	S	S	U	S	S	S	U	S	S	
I	4	Turning stock on lathe to produce a shoulder to .001 of an inch.	S	S	S	S	S	U	U	S	S	S	U	S	S	S	U	U	S	S	U	S	U	
I	5	Drilling stock on lathe to produce a hole to .005 of an inch.	S	S	S	S	U	S	S	U	U	U	S	U	S	S	S	S	S	S	S	S	S	
II	6	Reaming stock on lathe to produce a finished hole to .001 of an inch.	S	S	S	S	U	S	U	S	S	S	S	S	S	S	S	S	S	S	S	S	S	
II	7	Boring stock on lathe to produce an enlarged hole to .001 of an inch.	S	S	S	U	U	S	S	S	U	S	S	S	S	S	S	S	S	S	U	U	S	
II	8	Counterboring stock on lathe to produce a recessed hole to .005 of an inch.	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	
I	9	Parting stock on lathe to produce a piece within 1/32 of an inch.	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	
II	10	Necking stock on lathe to produce a necked shape to 1/32 of an inch.	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	
I	11	Filing stock on lathe to produce a finished surface.	S	S	S	S	U	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	
I	12	Machining stock on shaper to produce a flat surface.	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	
I	13	Machining stock on shaper to produce two parallel surfaces to .005 of an inch.	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	
I	14	Drilling stock on drill press to produce a hole to .005 of an inch.	S	S	S	S	U	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	
II	15	Reaming a hole on drill press to produce a finished hole to .001 of an inch.	S	S	S	S	U	S	S	S	S	S	S	S	S	S	S	S	S	U	S	S	S	
I	16	Spot facing a hole on drill press to produce a finished surface to .005 of an inch.	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	
I	17	Countersinking on drill press to produce a fastener receiver hole.	S	S	S	S	U	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	
II	18	Counterboring stock on drill press to produce an enlarged hole to .005 of an inch.	S	U	S	S	U	U	S	U	S	U	U	S	S	S	U	S	S	U	U	S	S	
I	19	Grinding stock on bench grinder to remove excess metal.	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	
I	20	Grinding drill bits on a bench grinder to sharpen tools.	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	

Figure 28.

			Student																				
Level	Task No.	Task Statement	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V
I	21	Grinding stock on surface grinder to produce a flat surface.	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	
I	22	Grinding stock on surface grinder to produce two parallel surfaces to .001 of an inch.	S	U	S	S	U	U	U	U	U	U	S	S	S	S	U	S	S	U	U	U	S	
II	23	Grinding stock on surface grinder to produce two perpendicular surfaces to .001 of an inch.	S	S	S	S	U	S	U	S	S	U	S	S	S	S	S	S	S	U	S	U	S	
II	24	Grinding stock on surface grinder to produce an angular surface.	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	
I	25	Machining stock on a horizontal milling machine to produce a flat surface.	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	
I	26	Machining stock on a horizontal milling machine to produce parallel surfaces to .001 of an inch.	S	S	S	S	U	U	U	S	U	S	S	S	S	U	U	S	S	U	S	U	S	
II	27	Machining stock on a horizontal milling machine to produce two perpendicular surfaces to .001 of an inch.	S	S	S	S	U	S	S	S	S	S	S	S	S	S	S	S	S	S	U	S	S	
II	28	Machining stock on a horizontal milling machine to produce a shoulder to .001 of an inch.	S	U	U	U	U	U	U	U	U	U	S	S	S	S	U	S	S	U	U	U	S	
II	29	Machining stock on a horizontal milling machine to produce an angular surface.	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	
I	30	Machining stock on a vertical milling machine to produce a flat surface.	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	
I	31	Machining stock on a vertical milling machine to produce two parallel surfaces to .001 of an inch.	S	S	S	S	U	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	
II	32	Machining stock on vertical milling machine to produce two perpendicular surfaces to .001 of an inch.	S	S	S	S	U	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	
II	33	Machining stock on vertical milling machine to produce a shoulder to .001 of an inch.	S	S	S	S	U	U	U	U	U	U	S	S	S	S	U	S	S	U	U	U	S	
		WELDING EXPERIENCES																					
		Arc welding ferrous metals with A.C. welder to produce:	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	
I	1	a horizontal butt joint.	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	
I	2	a horizontal lap joint.	S	S	S	S	U	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	
I	3	a horizontal outside corner joint.	S	S	S	S	U	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	
I	4	a horizontal inside corner joint.	S	S	S	S	U	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	
I	5	a horizontal tee joint.	S	S	S	S	U	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	
I	6	a vertical lap joint.	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	
II	7	Arc welding pipe stock with A.C. welder to produce a butt joint while fixed.	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	
II	8	Arc welding pipe stock with A.C. welder to produce butt joints while rolling.	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	

Figure 28, continued

			Student																			
Level	Task No.	Task Statement	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V
		Arc welding ferrous metals with D.C. welder to produce	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	
I	9	a horizontal butt joint.	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	
I	10	a horizontal lap joint.	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	
I	11	a horizontal outside corner joint.	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	
I	12	a horizontal inside corner joint.	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	
I	13	a horizontal tee joint.	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	
I	14	a vertical lap joint.	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	
II	15	Arc welding pipe stock with D.C. welder to produce butt joints while fixed.	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	
II	16	Arc welding pipe stock with D.C. welder to produce butt joints while rolling.	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	
I	17	Pad welding low areas on metal stock to renew stock to original height.	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	
		Gas welding ferrous metals stock to produce:																						
I	18	a horizontal butt joint.	S	S	S	S	U	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	
I	19	a horizontal lap joint.	S	S	S	S	U	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	
I	20	a horizontal outside corner joint.	S	S	S	S	U	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	
I	21	a horizontal inside corner joint.	S	S	S	S	U	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	
I	22	a horizontal tee joint.	S	S	S	S	U	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	
I	23	a vertical lap joint.	S	S	S	S	U	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	
I	24	Gas cutting ferrous carbon steels.	S	S	S	S	U	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	
		Brazing ferrous metals to produce:																						
I	25	a horizontal butt joint.	S	S	S	S	U	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	
I	26	a horizontal lap joint.	S	S	S	S	U	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	
I	27	a horizontal outside corner joint.	S	U	U	U	U	S	U	S	U	U	S	S	S	S	U	S	S	U	U	S	S	
I	28	a horizontal inside corner joint.	S	U	U	U	U	S	S	U	U	U	S	S	S	S	S	S	S	S	U	U	S	
I	29	a horizontal tee joint.	S	S	S	S	U	S	U	U	S	U	S	S	S	S	U	S	S	U	S	U	S	
I	30	a vertical lap joint.	S	U	U	U	U	S	U	S	S	S	S	S	S	S	S	S	S	S	S	S	S	
		Brazing non-ferrous metals to produce:																						
II	31	a horizontal butt joint.	S	S	S	S	U	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	
II	32	a horizontal lap joint.	S	S	S	S	U	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	
II	33	a horizontal outside corner joint.	S	S	S	S	U	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	
II	34	a horizontal inside corner joint.	S	U	U	U	U	S	S	U	U	U	S	S	S	S	U	S	S	S	U	U	S	
II	35	a horizontal tee joint.	S	S	S	S	U	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	
II	36	a vertical lap joint.	S	S	S	S	U	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	

Figure 28, continued

Level	Task No.	Task Statement	Student																					
			A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V
		Inert gas welding ferrous metals to produce:																						
II	37	a horizontal butt joint.	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	
II	38	a horizontal lap joint.	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	
II	39	a horizontal outside corner joint.	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	
II	40	a horizontal inside corner joint.	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	
II	41	a horizontal tee joint.	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	
II	42	a vertical lap joint.	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	
II	43	Inert gas welding pipe stock to produce butt joints while rolling.	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	
II	44	Inert gas welding pipe stock to produce butt joints while fixed.	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	
		Inert gas welding non-ferrous metals to produce:																						
II	45	a horizontal butt joint.	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	
II	46	a horizontal lap joint.	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	
II	47	a horizontal outside corner joint.	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	
II	48	a horizontal inside corner joint.	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	
II	49	a horizontal tee joint.	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	
II	50	a vertical lap joint.	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	
II	51	butt joints while rolling	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	
II	52	butt joints while fixed	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	
		SHEET METAL EXPERIENCES																						
I	1	Tracing templates on sheet metal for cutting, bending and joining sheet metal items.	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	
I	2	Cutting sheet metal with hand tools to produce a straight cut within 1/32 of an inch.	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	
II	3	Cutting sheet metal with machinery to produce a straight cut within 1/32 of an inch.	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	
I	4	Cutting sheet metal with hand tools to produce a circular cut within 1/32 of an inch.	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	
II	5	Cutting sheet metal with machinery to produce a circular cut within 1/32 of an inch.	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	
I	6	Cutting sheet metal with hand tools to produce an irregular cut within 1/32 of an inch.	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	
II	7	Cutting sheet metal with machinery to produce an irregular cut within 1/32 of an inch.	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	
I	8	Cutting sheet metal with hand tools to produce a notched cut within 1/32 of an inch.	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	

Figure 28, continued

Level	Task No.	Task Statement	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V
II	9	Cutting sheet metal with machinery to produce a notched cut within 1/32 of an inch.	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	
I	10	Cutting sheet metal to produce an interior cut within 1/32 of an inch.	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	
II	11	Forming sheet metal cylindrical shapes on slip roll forming machine.	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	
I	12	Forming sheet metal crimping on a crimping machine.	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	
I	13	Forming sheet metal beading on a beading machine.	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	
II	14	Forming single hem on bar folder or brake for strength.	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	
II	15	Forming double hem on bar folder or brake for strength.	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	
II	16	Forming single seam on a brake and/or bar folder for joining sheet metal parts.	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	
II	17	Forming double seam on a brake and/or bar folder for joining sheet metal parts.	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	
II	18	Forming Pittsburgh lock seam with machinery for joining sheet metal parts.	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	
II	19	Forming cap strip seam on a drive cap machine for joining sheet metal parts.	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	
I	20	Drilling sheet metal to produce a fastener receiver hole.	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	
II	21	Adhering sheet metal parts with adhesives to produce an assembly.	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	
II	22	Welding (spot) sheet metal parts to produce an assembly.	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	
II	23	Soldering sheet metal parts to produce an assembly.	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	
I	24	Fastening sheet metal parts with sheet metal screws to produce an assembly.	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	
[illegible]	25	Bolting sheet metal parts to produce an assembly.	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	
II	26	Riveting sheet metal parts to produce an assembly.	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	
[illegible]	27	Joining sheet metal parts with seams.	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	
		ASSEMBLY EXPERIENCES																						
[illegible]	1	Adhering parts with adhesives using hand processes to produce a metal bonded assembly	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	
II	2	Adhering parts with adhesives using spray equipment to a specified thickness to produce a metal bonded assembly.	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	

Figure 28, continued

			Student																				
Level	Task No.	Task Statement	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V
I	3	Fastening metal parts with screws to produce an assembly.	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	
I	4	Bolting metal parts with screws to produce an assembly.	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	
I	5	Riveting metal parts to produce an assembly.	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	
I	6	Tightening metal fasteners with hand power tools.	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	
II	7	Mating parts together to produce sub-assemblies.	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	
II	8	Mating parts and sub-assemblies together to produce major assemblies.	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	
I	9	Holding parts in clamping devices for assembly of details, sub-assemblies and assemblies.	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	
II	10	Cutting materials with hand tools to fit in an assembly.	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	
II	11	Cutting materials with power tools to fit in an assembly to 1/32 of an inch.	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	
I	12	Filing stock to produce a finished assembly to .001 of an inch.	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	
I	13	Drilling holes in material with hand drill to produce a hole to .005 of an inch.	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	
I	14	Drilling holes with a hand power drill to produce a hole to .005 of an inch.	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	
II	15	Reaming stock with hand wrench to produce a finished hole to .001 of an inch.	S	S	S	S	U	S	U	S	S	S	S	S	S	S	S	S	S	S	S	S	S	
II	16	Reaming stock with power drill to produce a finished hole to .001 of an inch.	S	S	S	S	U	S	U	S	S	S	S	S	S	S	S	S	S	S	S	S	S	
I	17	Countersinking holes with hand tools to produce a fastener receiver hole.	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	
I	18	Countersinking holes with power drill to produce a fastener receiver hole.	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	
II	19	Tapping holes with taps to produce a threaded hole.	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	
II	20	Cutting threads with dies to produce a threaded member.	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	
II	21	Punching materials with hand punches to produce a hole.	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	
II	22	Punching materials with power tools to produce an assembly.	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	

Figure 28, continued

			Student																					
Level	Task No.	Task Statement	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V
I	23	Checking dimensions of details with precision instruments for accurate assembly.	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	
I	24	Checking dimensions of sub-assemblies and assemblies to produce accurate assemblies.	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	
II	25	Measuring stock with precision instruments for assembly.	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	
I	26	Stamping number and letters on metal stock for identification.	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	
I	27	Hammering appropriate metal parts with various hammers.	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	
II	28	Flaring metal tubing with a flaring tool to produce a flare.	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	
II	29	Aligning parts in sub-assemblies and assemblies with hand tools.	S	S	S	S	U	S	U	S	S	S	S	S	S	S	S	S	S	S	S	S	S	

Figure 28, continued

SUMMARY-EVALUATION OF CLUSTER CONCEPT PILOT PROGRAM

SCHOOL E

	1	2	3	4	5
ADMINISTRATION	The school and county administrative personnel provided minimal moral and material support to the program and the teacher.		The school and county administrative personnel actively supported the program by furnishing the teacher with moral support but with less than satisfactory material support.		The school and county administrative personnel actively supported the program by furnishing the teacher with adequate moral and material support.
TEACHER	Little academic preparation in major field. Little or no teaching experience or practical experience in major field. Seldom shows resourcefulness or initiative.		Adequate academic preparation in major field. Has some teaching experience and some practical experience in major field. Sometime shows resourcefulness and initiative.		Superior academic preparation in major field. An experienced teacher with practical experience in major field. Resourceful. An initiator.
PHYSICAL FACILITIES	The size of the laboratory is inadequate and severely restricts occupational activities. The program also suffers from lack of equipment.		The size of the laboratory is adequate but somewhat restricts occupational activities. The laboratory has the minimum amount of equipment for operating the cluster program.		Size of the laboratory allows unrestricted occupational activities. The laboratory is suitably equipped for the cluster program.
INSTRUCTION	Tasks were taught in only one or two occupations. A very restricted number of Level I tasks were performed by the students. Few experiences offered were appropriate to the cluster.		Tasks were taught in several occupations. A majority of Level I tasks were performed by the students. Experiences were not always appropriate to occupations in the cluster.		Tasks were taught in all occupations. Most Level I tasks were performed by the students. Student experiences were extremely appropriate to occupations in the cluster.
COMMUNITY INVOLVEMENT	Community organizations were unaware of, or did not support the cluster program. Little opportunity for employment was evident in the community.		Community organizations furnished some support to the cluster program. Some members of the class found employment opportunity in the community.		Community organizations cooperated by furnishing aid to the program. A large proportion of the class found employment opportunity in the community.

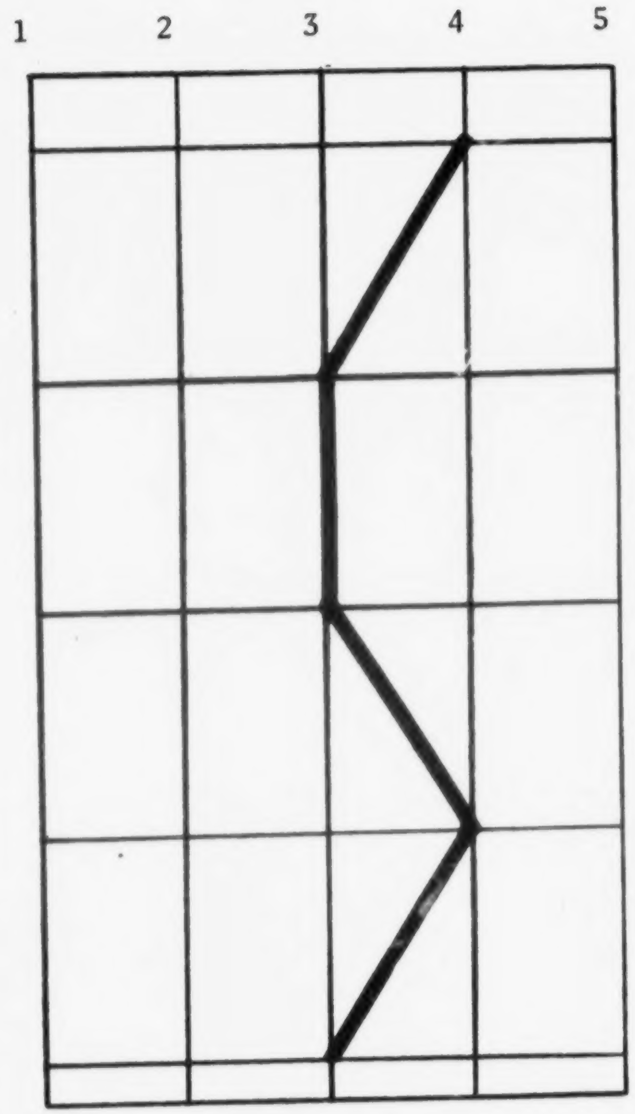


Figure 29.

Orientation. School J was located in a rural setting. Students in grades 10 through 12 were in attendance. The students could select either the college entrance, business, or general curriculum.

The introduction of the metal forming and fabrication cluster into this school marked the first time that a trade and industrial vocational course had been offered. Other practical areas of the curriculum included courses in business, home economics, industrial arts and agriculture.

The administration. The principal of School J supported the cluster program and the teacher. Were it not for his support in authorizing the use of school funds to be spent for material and supplies, there would have been no financial aid for the program in this school whatsoever.

The industrial education supervisor also supported the cluster concept idea and was instrumental in having Teacher J selected an an instructor for the pilot program. Unfortunately, his promotion of the cluster concept was not manifested in any material support in the form of tools, materials, and equipment.

In December, the supervisor of industrial education accompanied the principal investigator and the project coordinator on visitations to the schools in his county involved in the cluster concept program. However, he did not attend any of the scheduled visitations made by the research assistants to School B.

The teacher. Teacher J had a B.A. degree in Industrial Arts and had done additional graduate work. He had seven years experience in teaching general shop and twenty years experience in teaching metalworking. During World War II he conducted a National Defense class in aircraft sheet metal and machine shop practice. His practical work and avocational experiences were also associated with many areas of the metal forming and fabrication cluster. Teacher J was active in state, county, and local professional teacher associations as an officer and committee member.

Teacher J excelled in teaching, showing a sincere interest in students and a desire to help them grow both technically and socially. As a result, his students had a great respect for him. He maintained high standards in his class and showed great resourcefulness and initiative in bringing experiences to students which they would not receive in an average learning situation.

Physical facilities. Seventeen boys were enrolled in the metal forming and fabrication cluster in School J. The regular industrial arts laboratory occupied by Teacher J was utilized by the class. The facility was small for the diverse activites called for in the cluster curriculum. However, it had equipment that enabled Teacher J to teach many of the tasks in the cluster. Approximately 50 percent of the tools, materials, and equipment recommended for the cluster were on hand at the beginning of the year. No additional items were received during the course of the school year.

A detailed drawing of the laboratory in which the cluster program was conducted is shown at the end of this section. This drawing also indicates major pieces of equipment and shows their location in the laboratory. See Illustration 8.

Instruction. The students gained experiences in all occupations of the cluster although this experience was somewhat limited due to a lack of tools, materials, and equipment. Students progressed from practice pieces to numerous types of projects, some of a personal nature and several for use within the school. The projects which incorporated tasks from each of the occupations in the cluster included two snow blowers, a rack to hold eight bar bell sets and a utility trailer.

Field trips were made to the Pangborn Corporation and Fairchild Corporation in Hagerstown and to the Goddard Space Flight Center in Greenbelt. These visits enabled the students to see many of the most modern industrial processes related with the metal forming and fabrication cluster.

In order to evaluate the performance of each student enrolled in the metal forming and fabrication cluster a task inventory was developed. This inventory listed all the tasks to be taught in the metal forming and fabrication cluster . When kept up-to-date, it represented a record of student progress and achievement to teachers, parents, pupils, and frequently, employers.

The task evaluation charts located at the end of this section are of two types. One list indicates the tasks which were to be taught in the cluster concept program. Those tasks taught this year are indicated by a check (✓). Those tasks taught this year which the teacher feels need to be retaught next year are indicated by a double check mark (✓✓). See Figure 30.

The second evaluation chart indicates, in the teacher's opinion, how each student in his class was able to perform the task. Each student received either a satisfactory (S) or unsatisfactory (U) as an evaluation of his achievement. Those tasks not taught during the first year of the pilot program were indicated by the letter (N). See Figure 31.

Community involvement. Through field trips, Teacher J made some useful contacts with industries in the area. One company furnished the class with a supply of stock for welding practice and another offered some good possibilities for future employment opportunities for the students.

As a result of the performance of some maintenance and repair operations for local citizens, the class received some recognition from the community.

A visual summary of the preceding five areas, administration, teacher, physical facilities, instruction, and community involvement, which have been featured in the description of the pilot program at School J is presented in Figure 32.

Summary and recommendation. The students in the metal forming and fabrication cluster at School J had the benefit of learning from an excellent and dedicated teacher. They received a well-rounded experience not only in the classroom but on field trips as well.

Lack of tools, materials, and equipment seriously handicapped the program despite the efforts of Teacher J to do the best job possible with what he had at hand. Although the laboratory was small, this was not considered a serious drawback since space was available for the additional equipment which was recommended for the project.

Although the facility was small for the activities engaged in, there does not appear to be any solution to this problem in School J. The program could be significantly improved during the second year of the pilot program if the recommended tools, materials, and equipment are on hand when school opens in September, 1968.

The pictures at the end of this section represent typical activities engaged in by students enrolled in the metal forming and fabrication cluster.

SCHOOL J

METAL FORMING & FABRICATION CLUSTER

1. GEM SANDER
2. TOOL CABINET
3. BUFFER
4. SINK
5. WELDING
6. BRAZING
7. COMPRESSOR
8. SQUARING SHEARS
9. DIAMOND SAW
10. BAND SAW (METAL)
11. SOLDERING BENCH
12. FOUNDRY BENCH
13. GAS FURNACE
14. MILLING MACHINE
15. HACKSAW
16. GEM POLISHER
17. GEM GRINDER
18. PLANNING AREA
19. BAR FOLDER AND FORMING ROLLS
20. STAKE BENCH
21. ANVILS
22. WORK BENCH
23. ARBOR PRESS
24. ENGINE LATHE
25. DRILL PRESS
26. SUPPLY CABINETS
27. FILE CABINET
28. TEACHER'S LOCKER
29. DESK
30. SHEET METAL ROTARY MACHINES
31. SHAPER
32. GRINDER
33. METAL STORAGE

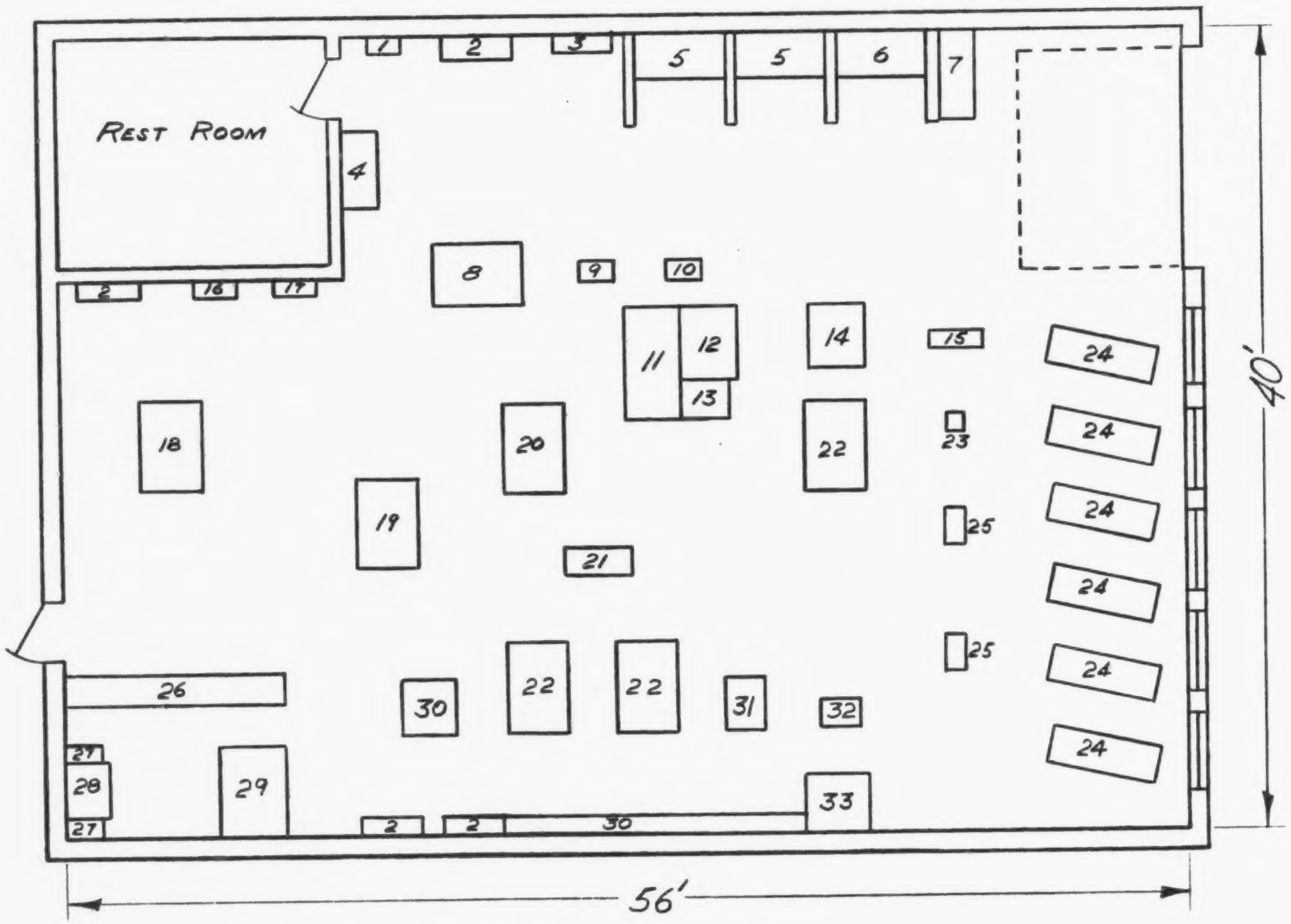

REST ROOM
1
2
3
5
5
6
7
4
8
9
10
11
12
13
14
15
16
17
2
18
19
20
21
22
22
22
23
24
24
24
24
24
24
25
25
26
27
28
27
29
30
31
32
33
2
2
30
40'
56'

ILLUSTRATION 8

TASK EVALUATION CHART

MACHINING EXPERIENCES

Level	Task No.	Task Statement	
I	1	Turning stock on lathe to produce a faced surface.	✓
I	2	Countersinking (countersink and center drill) stock to produce a tapered hole for mounting stock between centers.	✓
I	3	Turning stock on lathe to produce a cyclindrical shape to .001 inch.	✓✓
I	4	Turning stock on lathe to produce a shoulder to .001 of an inch.	✓✓
I	5	Drilling stock on lathe to produce a hole to .005 of an inch.	✓
II	6	Reaming stock on lathe to produce a finished hole to .001 of an inch.	✓
II	7	Boring stock on lathe to produce an enlarged hole to .001 of an inch.	✓✓
II	8	Counterboring stock on lathe to produce a recessed hole to .005 of an inch.	✓
I	9	Parting stock on lathe to produce a piece within 1/32 of an inch.	✓
II	10	Necking stock on lathe to produce a necked shape to 1/32 of an inch.	✓
I	11	Filing stock on lathe to produce a finished surface.	✓
I	12	Machining stock on shaper to produce a flat surface.	✓
I	13	Machining stock on shaper to produce two parallel surfaces to .005 of an inch.	✓✓
I	14	Drilling stock on drill press to produce a hole to .005 of an inch.	✓
II	15	Reaming a hole on drill press to produce a finished hole to .001 of an inch.	✓
I	16	Spot facing a hole on drill press to produce a finished surface to .005 of an inch.	✓✓
I	17	Countersinking on drill press to produce a fastener receiver hole.	✓
II	18	Counterboring stock on drill press to produce an enlarged hole to .005 of an inch.	✓✓
I	19	Grinding stock on bench grinder to remove excess metal.	✓
I	20	Grinding drill bits on a bench grinder to sharpen tools.	✓✓
I	21	Grinding stock on surface grinder to produce a flat surface.	✓
I	22	Grinding stock on surface grinder to produce two parallel surfaces to .001 of an inch.	✓✓
II	23	Grinding stock on surface grinder to produce two perpendicular surfaces to .001 of an inch.	✓✓
II	24	Grinding stock on surface grinder to produce an angular surface.	✓
I	25	Machining stock on a horizontal milling machine to produce a flat surface.	✓
I	26	Machining stock on a horizontal milling machine to produce parallel surfaces to .001 of an inch.	✓✓
II	27	Machining stock on a horizontal milling machine to produce two perpendicular surfaces to .001 of an inch.	✓✓
II	28	Machining stock on a horizontal milling machine to produce a shoulder to .001 of an inch.	✓✓
II	29	Machining stock on a horizontal milling machine to produce an angular surface.	✓
I	30	Machining stock on a vertical milling machine to produce a flat surface.	✓
I	31	Machining stock on a vertical milling machine to produce two parallel surfaces to .001 of an inch.	✓✓
II	32	Machining stock on vertical milling machine to produce two perpendicular surfaces to .001 of an inch.	✓✓
II	33	Machining stock on vertical milling machine to produce a shoulder to .001 of an inch.	✓✓
		WELDING EXPERIENCES	
		Arc welding ferrous metals with A.C. welder to produce:	
I	1	a horizontal butt joint.	✓
I	2	a horizontal lap joint.	✓
I	3	a horizontal outside corner joint.	✓
I	4	a horizontal inside corner joint.	✓
I	5	a horizontal tee joint.	✓
I	6	a vertical lap joint.	✓
II	7	Arc welding pipe stock with A.C. welder to produce a butt joint while fixed.	✓✓
II	8	Arc welding pipe stock with A.C. welder to produce butt joints while rolling.	✓✓

Figure 30.

Level	Task No.	Task Statement	
		Arc welding ferrous metals with D.C. welder to produce	
I	9	a horizontal butt joint.	✓✓
I	10	a horizontal lap joint.	✓✓
I	11	a horizontal outside corner joint.	✓✓
I	12	a horizontal inside corner joint.	✓✓
I	13	a horizontal tee joint.	✓✓
I	14	a vertical lap joint.	✓✓
II	15	Arc welding pipe stock with D.C. welder to produce butt joints while fixed.	✓✓
II	16	Arc welding pipe stock with D.C. welder to produce butt joints while rolling.	✓✓
I	17	Pad welding low areas on metal stock to renew stock to original height.	✓
		Gas welding ferrous metals stock to produce:	
I	18	a horizontal butt joint.	✓
I	19	a horizontal lap joint.	✓
I	20	a horizontal outside corner joint.	✓✓
I	21	a horizontal inside corner joint.	✓✓
I	22	a horizontal tee joint.	✓✓
I	23	a vertical lap joint.	✓✓
I	24	Gas cutting ferrous carbon steels.	✓
		Brazing ferrous metals to produce:	
I	25	a horizontal butt joint.	✓
I	26	a horizontal lap joint.	✓
I	27	a horizontal outside corner joint.	✓
I	28	a horizontal inside corner joint.	✓
I	29	a horizontal tee joint.	✓
I	30	a vertical lap joint.	✓✓
		Brazing non-ferrous metals to produce:	
II	31	a horizontal butt joint.	✓✓
II	32	a horizontal lap joint.	✓✓
II	33	a horizontal outside corner joint.	✓✓
II	34	a horizontal inside corner joint.	✓✓
II	35	a horizontal tee joint.	✓✓
II	36	a vertical lap joint.	✓✓

Figure 30, continued

Level	Task No.	Task Statement	
		Inert gas welding ferrous metals to produce:	
II	37	a horizontal butt joint.	
II	38	a horizontal lap joint.	
II	39	a horizontal outside corner joint.	
II	40	a horizontal inside corner joint.	
II	41	a horizontal tee joint.	
II	42	a vertical lap joint.	
II	43	Inert gas welding pipe stock to produce butt joints while rolling.	
II	44	Inert gas welding pipe stock to produce butt joints while fixed.	
		Inert gas welding non-ferrous metals to produce:	
II	45	a horizontal butt joint.	
II	46	a horizontal lap joint.	
II	47	a horizontal outside corner joint.	
II	48	a horizontal inside corner joint.	
II	49	a horizontal tee joint.	
II	50	a vertical lap joint.	
II	51	butt joints while rolling	
II	52	butt joints while fixed	
		SHEET METAL EXPERIENCES	
I	1	Tracing templates on sheet metal for cutting, bending and joining sheet metal items.	✓
I	2	Cutting sheet metal with hand tools to produce a straight cut within 1/32 of an inch.	✓✓
II	3	Cutting sheet metal with machinery to produce a straight cut within 1/32 of an inch.	✓
I	4	Cutting sheet metal with hand tools to produce a circular cut within 1/32 of an inch.	✓✓
II	5	Cutting sheet metal with machinery to produce a circular cut within 1/32 of an inch.	✓✓
I	6	Cutting sheet metal with hand tools to produce an irregular cut within 1/32 of an inch.	✓
II	7	Cutting sheet metal with machinery to produce an irregular cut within 1/32 of an inch.	✓
I	8	Cutting sheet metal with hand tools to produce a notched cut within 1/32 of an inch.	✓

Level	Task No.	Task Statement	
II	9	Cutting sheet metal with machinery to produce a notched cut within 1/32 of an inch.	✓
I	10	Cutting sheet metal to produce an interior cut within 1/32 of an inch.	✓✓
II	11	Forming sheet metal cylindrical shapes on slip roll forming machine.	✓
I	12	Forming sheet metal crimping on a crimping machine.	✓
I	13	Forming sheet metal beading on a beading machine.	✓
II	14	Forming single hem on bar folder or brake for strength.	✓
II	15	Forming double hem on bar folder or brake for strength.	✓
II	16	Forming single seam on a brake and/or bar folder for joining sheet metal parts.	✓
II	17	Forming double seam on a brake and/or bar folder for joining sheet metal parts.	✓
II	18	Forming Pittsburgh lock seam with machinery for joining sheet metal parts.	✓✓
II	19	Forming cap strip seam on a drive cap machine for joining sheet metal parts.	
I	20	Drilling sheet metal to produce a fastener receiver hole.	✓
II	21	Adhering sheet metal parts with adhesives to produce an assembly.	✓✓
II	22	Welding (spot) sheet metal parts to produce an assembly.	✓
II	23	Soldering sheet metal parts to produce an assembly.	✓
I	24	Fastening sheet metal parts with sheet metal screws to produce an assembly.	✓
[illegible]	25	Bolting sheet metal parts to produce an assembly.	✓
II	26	Riveting sheet metal parts to produce an assembly.	✓
[illegible]	27	Joining sheet metal parts with seams.	✓
		ASSEMBLY EXPERIENCES	
[illegible]	1	Adhering parts with adhesives using hand processes to produce a metal bonded assembly	✓
II	[illegible]	Adhering parts with adhesives using spray equipment to a specified thickness to produce a metal bonded assembly.	

Figure 30, continued

Level	Task No.	Task Statement	
I	3	Fastening metal parts with screws to produce an assembly.	✓
I	4	Bolting metal parts with screws to produce an assembly.	✓
I	5	Riveting metal parts to produce an assembly.	✓
I	6	Tightening metal fasteners with hand power tools.	✓
II	7	Mating parts together to produce sub-assemblies.	✓
II	8	Mating parts and sub-assemblies together to produce major assemblies.	✓
I	9	Holding parts in clamping devices for assembly of details, sub-assemblies and assemblies.	✓
II	10	Cutting materials with hand tools to fit in an assembly.	✓
II	11	Cutting materials with power tools to fit in an assembly to 1/32 of an inch.	✓✓
I	12	Filing stock to produce a finished assembly to .001 of an inch.	✓
I	13	Drilling holes in material with hand drill to produce a hole to .005 of an inch.	✓
I	14	Drilling holes with a hand power drill to produce a hole to .005 of an inch.	✓
II	15	Reaming stock with hand wrench to produce a finished hole to .001 of an inch.	
II	16	Reaming stock with power drill to produce a finished hole to .001 of an inch.	✓
I	17	Countersinking holes with hand tools to produce a fastener receiver hole.	✓
I	18	Countersinking holes with power drill to produce a fastener receiver hole.	✓
II	19	Tapping holes with taps to produce a threaded hole.	✓
II	20	Cutting threads with dies to produce a threaded member.	✓
II	21	Punching materials with hand punches to produce a hole.	✓
II	22	Punching materials with power tools to produce an assembly.	✓

Level	Task No.	Task Statement	
I	23	Checking dimensions of details with precision instruments for accurate assembly.	✓✓
I	24	Checking dimensions of sub-assemblies and assemblies to produce accurate assemblies.	✓
II	25	Measuring stock with precision instruments for assembly.	✓
I	26	Stamping number and letters on metal stock for identification.	✓
I	27	Hammering appropriate metal parts with various hammers.	✓
II	28	Flaring metal tubing with a flaring tool to produce a flare.	✓
II	29	Aligning parts in sub-assemblies and assemblies with hand tools.	✓

Figure 30, continued

TASK EVALUATION CHART

MACHINING EXPERIENCES

Student

Level	Task No.	Task Statement	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V
I	1	Turning stock on lathe to produce a faced surface.	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S							
I	2	Countersinking (countersink and center drill) stock to produce a tapered hole for mounting stock between centers.	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S							
I	3	Turning stock on lathe to produce a cyclindrical shape to .001 inch.	S	S	U	S	S	U	S	S	U	S	S	U	S	S	S							
I	4	Turning stock on lathe to produce a shoulder to .001 of an inch.	S	S	U	S	S	S	S	U	U	U	S	U	S	S	S							
I	5	Drilling stock on lathe to produce a hole to .005 of an inch.	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S							
II	6	Reaming stock on lathe to produce a finished hole to .001 of an inch.	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S							
II	7	Boring stock on lathe to produce an enlarged hole to .001 of an inch.	S	U	U	S	U	S	U	U	S	S	S	U	S	S	U							
II	8	Counterboring stock on lathe to produce a recessed hole to .005 of an inch.	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S							
I	9	Parting stock on lathe to produce a piece within 1/32 of an inch.	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S							
II	10	Necking stock on lathe to produce a necked shape to 1/32 of an inch.	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S							
I	11	Filing stock on lathe to produce a finished surface.	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S							
I	12	Machining stock on shaper to produce a flat surface.	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S							
I	13	Machining stock on shaper to produce two parallel surfaces to .005 of an inch.	U	S	U	S	U	U	S	U	U	S	S	U	S	S	S							
I	14	Drilling stock on drill press to produce a hole to .005 of an inch.	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S							
II	15	Reaming a hole on drill press to produce a finished hole to .001 of an inch.	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S							
I	16	Spot facing a hole on drill press to produce a finished surface to .005 of an inch.	S	S	S	S	S	U	S	U	S	U	S	U	S	U	S							
I	17	Countersinking on drill press to produce a fastener receiver hole.	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S							
II	18	Counterboring stock on drill press to produce an enlarged hole to .005 of an inch.	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U							
I	19	Grinding stock on bench grinder to remove excess metal.	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S							
I	20	Grinding drill bits on a bench grinder to sharpen tools.	S	S	S	U	U	S	U	S	S	S	S	S	U	U	U							

Figure 31.

Level	Task No.	Task Statement	Student																				
			A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V
I	21	Grinding stock on surface grinder to produce a flat surface.	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S							
I	22	Grinding stock on surface grinder to produce two parallel surfaces to .001 of an inch.	S	S	S	U	S	S	S	S	S	U	S	U	S	S	S							
II	23	Grinding stock on surface grinder to produce two perpendicular surfaces to .001 of an inch.	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U							
II	24	Grinding stock on surface grinder to produce an angular surface.	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S							
I	25	Machining stock on a horizontal milling machine to produce a flat surface.	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S							
I	26	Machining stock on a horizontal milling machine to produce parallel surfaces to .001 of an inch.	S	U	U	U	U	S	U	U	U	U	S	U	U	U	U							
II	27	Machining stock on a horizontal milling machine to produce two perpendicular surfaces to .001 of an inch.	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U							
II	28	Machining stock on a horizontal milling machine to produce a shoulder to .001 of an inch.	S	U	U	U	U	S	U	U	U	U	U	U	U	S	S							
II	29	Machining stock on a horizontal milling machine to produce an angular surface.	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S							
I	30	Machining stock on a vertical milling machine to produce a flat surface.	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S							
I	31	Machining stock on a vertical milling machine to produce two parallel surfaces to .001 of an inch.	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U							
II	32	Machining stock on vertical milling machine to produce two perpendicular surfaces to .001 of an inch.	S	U	U	U	U	U	U	U	U	U	U	U	U	U	U							
II	33	Machining stock on vertical milling machine to produce a shoulder to .001 of an inch.	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U							
		WELDING EXPERIENCES																						
		Arc welding ferrous metals with A.C. welder to produce:																						
I	1	a horizontal butt joint.	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S							
I	2	a horizontal lap joint.	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S							
I	3	a horizontal outside corner joint.	S	S	S	S	S	S	S	S	S	S	S	U	S	S	S							
I	4	a horizontal inside corner joint.	S	S	S	S	S	S	S	S	S	S	S	U	S	S	S							
I	5	a horizontal tee joint.	S	S	S	S	S	S	S	S	S	S	S	U	S	S	S							
I	6	a vertical lap joint.	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S							
II	7	Arc welding pipe stock with A.C. welder to produce a butt joint while fixed.	S	S	U	S	U	S	S	U	U	U	S	U	U	U	U							
II	8	Arc welding pipe stock with A.C. welder to produce butt joints while rolling.	S	S	U	U	S	U	S	U	S	U	S	U	U	U	S							

Figure 31, continued

			Student																					
Level	Task No.	Task Statement	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V
		Arc welding ferrous metals with D.C. welder to produce																						
I	9	a horizontal butt joint.	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S							
I	10	a horizontal lap joint.	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S							
I	11	a horizontal outside corner joint.	S	S	U	S	S	S	S	S	S	S	S	S	S	S	S							
I	12	a horizontal inside corner joint.	S	S	U	S	S	U	S	U	S	U	S	U	S	S	S							
I	13	a horizontal tee joint.	S	S	S	S	S	S	S	S	S	U	S	U	S	S	S							
I	14	a vertical lap joint.	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S							
II	15	Arc welding pipe stock with D.C. welder to produce butt joints while fixed.	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U							
II	16	Arc welding pipe stock with D.C. welder to produce butt joints while rolling.	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U							
I	17	Pad welding low areas on metal stock to renew stock to original height.	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S							
		Gas welding ferrous metals stock to produce:																						
I	18	a horizontal butt joint.	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S							
I	19	a horizontal lap joint.	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S							
I	20	a horizontal outside corner joint.	S	S	S	S	S	S	U	S	S	S	S	U	S	S	S							
I	21	a horizontal inside corner joint.	U	U	U	S	S	S	S	S	U	U	U	S	S	U	S							
I	22	a horizontal tee joint.	S	S	S	U	U	S	U	S	U	U	S	S	U	U	S							
I	23	a vertical lap joint.	S	S	S	U	S	S	S	U	U	S	S	U	S	S	U							
I	24	Gas cutting ferrous carbon steels.	S	S	S	S	S	U	S	S	S	S	S	S	S	S	S							
		Brazing ferrous metals to produce:																						
I	25	a horizontal butt joint.	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S							
I	26	a horizontal lap joint.	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S							
I	27	a horizontal outside corner joint.	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S							
I	28	a horizontal inside corner joint.	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S							
I	29	a horizontal tee joint.	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S							
I	30	a vertical lap joint.	S	S	U	U	S	S	U	U	U	U	U	U	U	U	S							
		Brazing non-ferrous metals to produce:																						
II	31	a horizontal butt joint.	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U							
II	32	a horizontal lap joint.	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U							
II	33	a horizontal outside corner joint.	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U							
II	34	a horizontal inside corner joint.	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U							
II	35	a horizontal tee joint.	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U							
II	36	a vertical lap joint	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U							

Figure 31, continued

			Student																					
Level	Task No.	Task Statement	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V
		Inert gas welding ferrous metals to produce:																						
II	37	a horizontal butt joint.	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N							
II	38	a horizontal lap joint.	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N							
II	39	a horizontal outside corner joint.	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N							
II	40	a horizontal inside corner joint.	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N							
II	41	a horizontal tee joint.	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N							
II	42	a vertical lap joint.	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N							
II	43	Inert gas welding pipe stock to produce butt joints while rolling.	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N							
II	44	Inert gas welding pipe stock to produce butt joints while fixed.	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N							
		Inert gas welding non-ferrous metals to produce:																						
II	45	a horizontal butt joint.	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N							
II	46	a horizontal lap joint.	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N							
II	47	a horizontal outside corner joint.	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N							
II	48	a horizontal inside corner joint.	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N							
II	49	a horizontal tee joint.	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N							
II	50	a vertical lap joint.	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N							
II	51	butt joints while rolling	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N							
II	52	butt joints while fixed	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N							
		SHEET METAL EXPERIENCES																						
I	1	Tracing templates on sheet metal for cutting, bending and joining sheet metal items.	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S							
I	2	Cutting sheet metal with hand tools to produce a straight cut within 1/32 of an inch.	S	S	U	S	U	U	S	U	U	S	U	S	S	S	S							
II	3	Cutting sheet metal with machinery to produce a straight cut within 1/32 of an inch.	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S							
I	4	Cutting sheet metal with hand tools to produce a circular cut within 1/32 of an inch.	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U							
II	5	Cutting sheet metal with machinery to produce a circular cut within 1/32 of an inch.	S	U	S	U	S	U	U	S	U	S	S	S	U	U	U							
I	6	Cutting sheet metal with hand tools to produce an irregular cut within 1/32 of an inch.	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S							
II	7	Cutting sheet metal with machinery to produce an irregular cut within 1/32 of an inch.	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S							
I	8	Cutting sheet metal with hand tools to produce a notched cut within 1/32 of an inch.	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S							

Figure 31, continued

			Student																			
Level	Task No.	Task Statement	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V
II	9	Cutting sheet metal with machinery to produce a notched cut within 1/32 of an inch.	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S							
I	10	Cutting sheet metal to produce an interior cut within 1/32 of an inch.	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U							
II	11	Forming sheet metal cylindrical shapes on slip roll forming machine.	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S							
I	12	Forming sheet metal crimping on a crimping machine.	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S							
I	13	Forming sheet metal beading on a beading machine.	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S							
II	14	Forming single hem on bar folder or brake for strength.	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S							
II	15	Forming double hem on bar folder or brake for strength.	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S							
II	16	Forming single seam on a brake and/or bar folder for joining sheet metal parts.	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S							
II	17	Forming double seam on a brake and/or bar folder for joining sheet metal parts.	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S							
II	18	Forming Pittsburgh lock seam with machinery for joining sheet metal parts.	U	U	U	U	S	S	S	U	U	S	U	U	S	S	S							
II	19	Forming cap strip seam on a drive cap machine for joining sheet metal parts.	S	U	U	S	S	U	S	U	U	U	S	U	S	S	S							
I	20	Drilling sheet metal to produce a fastener receiver hole.	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S							
II	21	Adhering sheet metal parts with adhesives to produce an assembly.	S	S	S	S	S	S	S	U	S	S	S	U	S	S	S							
II	22	Welding (spot) sheet metal parts to produce an assembly.	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S							
II	23	Soldering sheet metal parts to produce an assembly.	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S							
I	24	Fastening sheet metal parts with sheet metal screws to produce an assembly.	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S							
.	25	Bolting sheet metal parts to produce an assembly.	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S							
II	26	Riveting sheet metal parts to produce an assembly.	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S							
.	27	Joining sheet metal parts with seams.	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S							
		ASSEMBLY EXPERIENCES																						
.	1	Adhering parts with adhesives using hand processes to produce a metal bonded assembly	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S							
II	2	Adhering parts with adhesives using spray equipment to a specified thickness to produce a metal bonded assembly.	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N							

Figure 31, continued

Level	Task No.	Task Statement	Student																					
			A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V
I	3	Fastening metal parts with screws to produce an assembly.	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S							
I	4	Bolting metal parts with screws to produce an assembly.	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S							
I	5	Riveting metal parts to produce an assembly.	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S							
I	6	Tightening metal fasteners with hand power tools.	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S							
II	7	Mating parts together to produce sub-assemblies.	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S							
II	8	Mating parts and sub-assemblies together to produce major assemblies.	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S							
I	9	Holding parts in clamping devices for assembly of details, sub-assemblies and assemblies.	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S							
II	10	Cutting materials with hand tools to fit in an assembly.	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S							
II	11	Cutting materials with power tools to fit in an assembly to 1/32 of an inch.	S	U	S	U	S	U	U	S	U	S	S	S	S	S	S							
I	12	Filing stock to produce a finished assembly to .001 of an inch.	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S							
I	13	Drilling holes in material with hand drill to produce a hole to .005 of an inch.	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S							
I	14	Drilling holes with a hand power drill to produce a hole to .005 of an inch.	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S							
II	15	Reaming stock with hand wrench to produce a finished hole to .001 of an inch.	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N							
II	16	Reaming stock with power drill to produce a finished hole to .001 of an inch.	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S							
I	17	Countersinking holes with hand tools to produce a fastener receiver hole.	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S							
I	18	Countersinking holes with power drill to produce a fastener receiver hole.	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S							
II	19	Tapping holes with taps to produce a threaded hole.	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S							
II	20	Cutting threads with dies to produce a threaded member.	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S							
II	21	Punching materials with hand punches to produce a hole.	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S							
II	22	Punching materials with power tools to produce an assembly.	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S							

Figure 31, continued

Level	Task No.	Task Statement	Student																					
			A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V
I	23	Checking dimensions of details with precision instruments for accurate assembly.	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U							
I	24	Checking dimensions of sub-assemblies and assemblies to produce accurate assemblies.	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S							
II	25	Measuring stock with precision instruments for assembly.	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S							
I	26	Stamping number and letters on metal stock for identification.	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S							
I	27	Hammering appropriate metal parts with various hammers.	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S							
II	28	Flaring metal tubing with a flaring tool to produce a flare.	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S							
II	29	Aligning parts in sub-assemblies and assemblies with hand tools.	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S							

Figure 31, continued

SUMMARY-EVALUATION OF CLUSTER CONCEPT PILOT PROGRAM

SCHOOL J

1	2	3	4	5
ADMINISTRATION The school and county administrative personnel provided minimal moral and material support to the program and the teacher.		The school and county administrative personnel actively supported the program by furnishing the teacher with moral support but with less than satisfactory material support.		The school and county administrative personnel actively supported the program by furnishing the teacher with adequate moral and material support.
TEACHER Little academic preparation in major field. Little or no teaching experience or practical experience in major field. Seldom shows resourcefulness or initiative.		Adequate academic preparation in major field. Has some teaching experience and some practical experience in major field. Sometime shows resourcefulness and initiative.		Superior academic preparation in major field. An experienced teacher with practical experience in major field. Resourceful. An initiator.
PHYSICAL FACILITIES The size of the laboratory is inadequate and severely restricts occupational activities. The program also suffers from lack of equipment.		The size of the laboratory is adequate but somewhat restricts occupational activities. The laboratory has the minimum amount of equipment for operating the cluster program.		Size of the laboratory allows unrestricted occupational activities. The laboratory is suitably equipped for the cluster program.
INSTRUCTION Tasks were taught in only one or two occupations. A very restricted number of Level I tasks were performed by the students. Few experiences offered were appropriate to the cluster.		Tasks were taught in several occupations. A majority of Level I tasks were performed by the students. Experiences were not always appropriate to occupations in the cluster.		Tasks were taught in all occupations. Most Level I tasks were performed by the students. Student experiences were extremely appropriate to occupations in the cluster.
COMMUNITY INVOLVEMENT Community organizations were unaware of, or did not support the cluster program. Little opportunity for employment was evident in the community.		Community organizations furnished some support to the cluster program. Some members of the class found employment opportunity in the community.		Community organizations cooperated by furnishing aid to the program. A large proportion of the class found employment opportunity in the community.

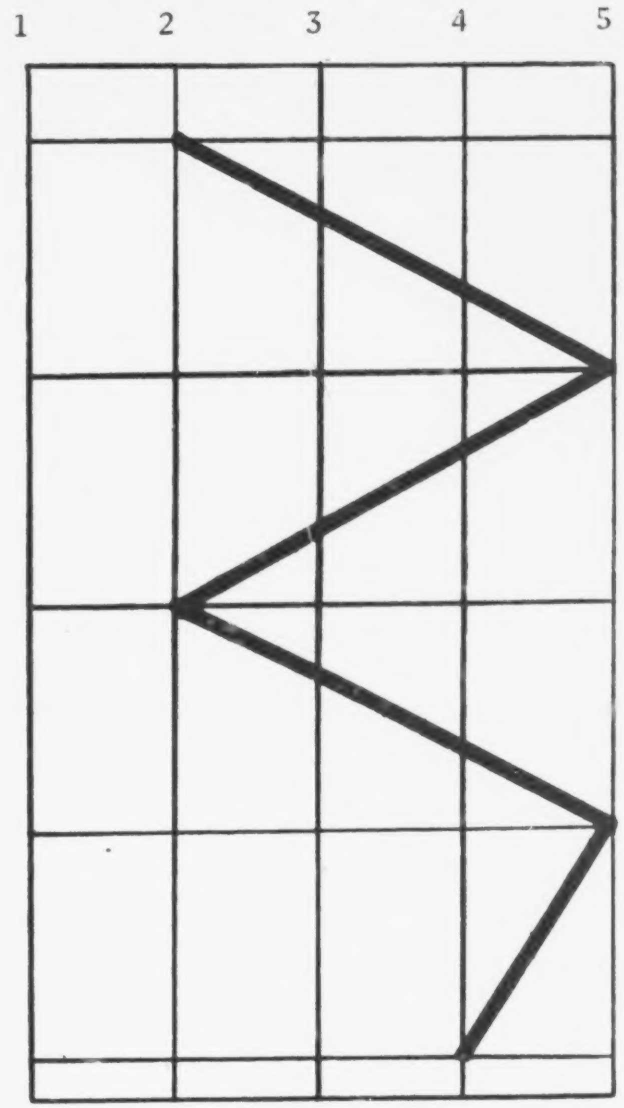
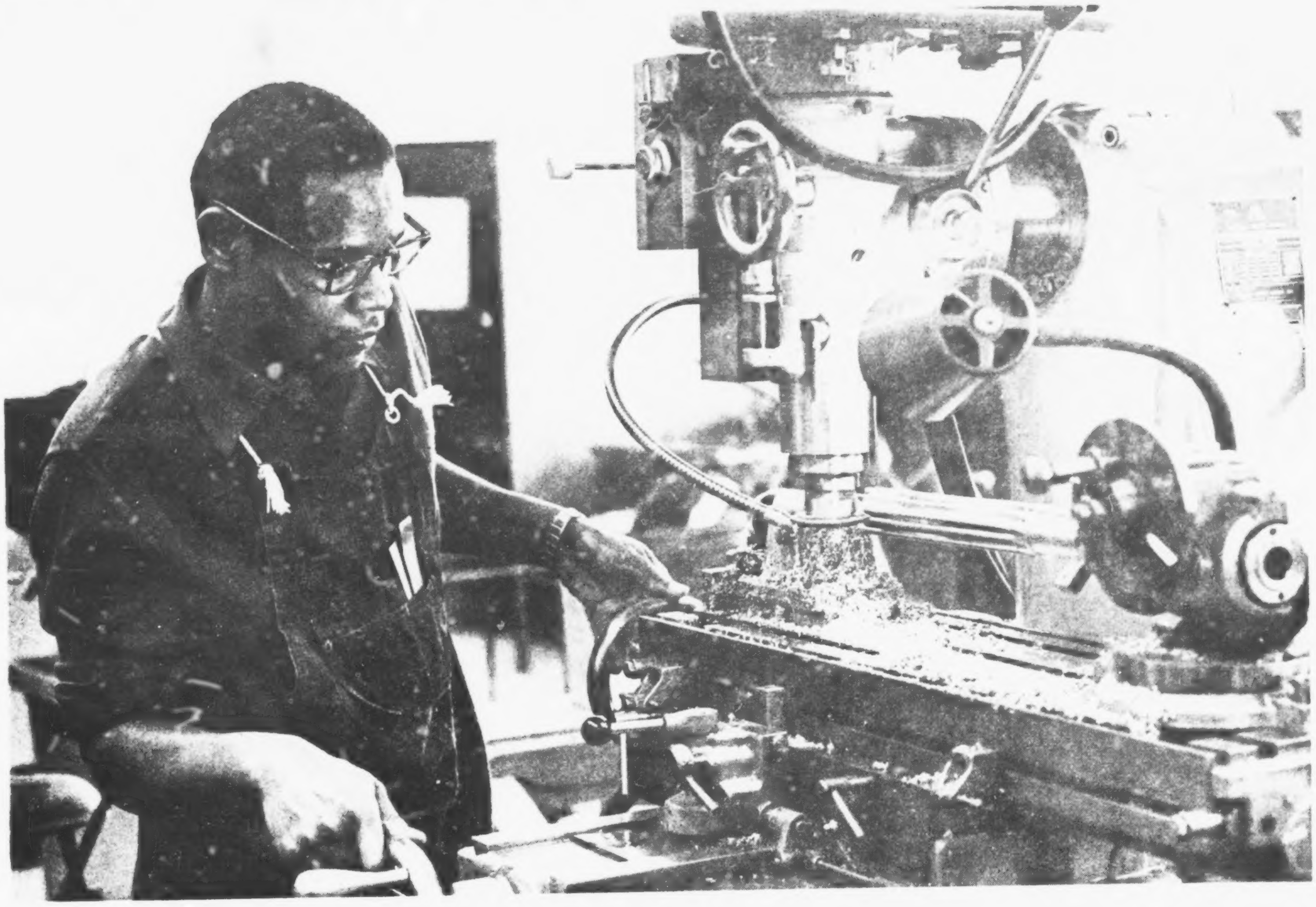
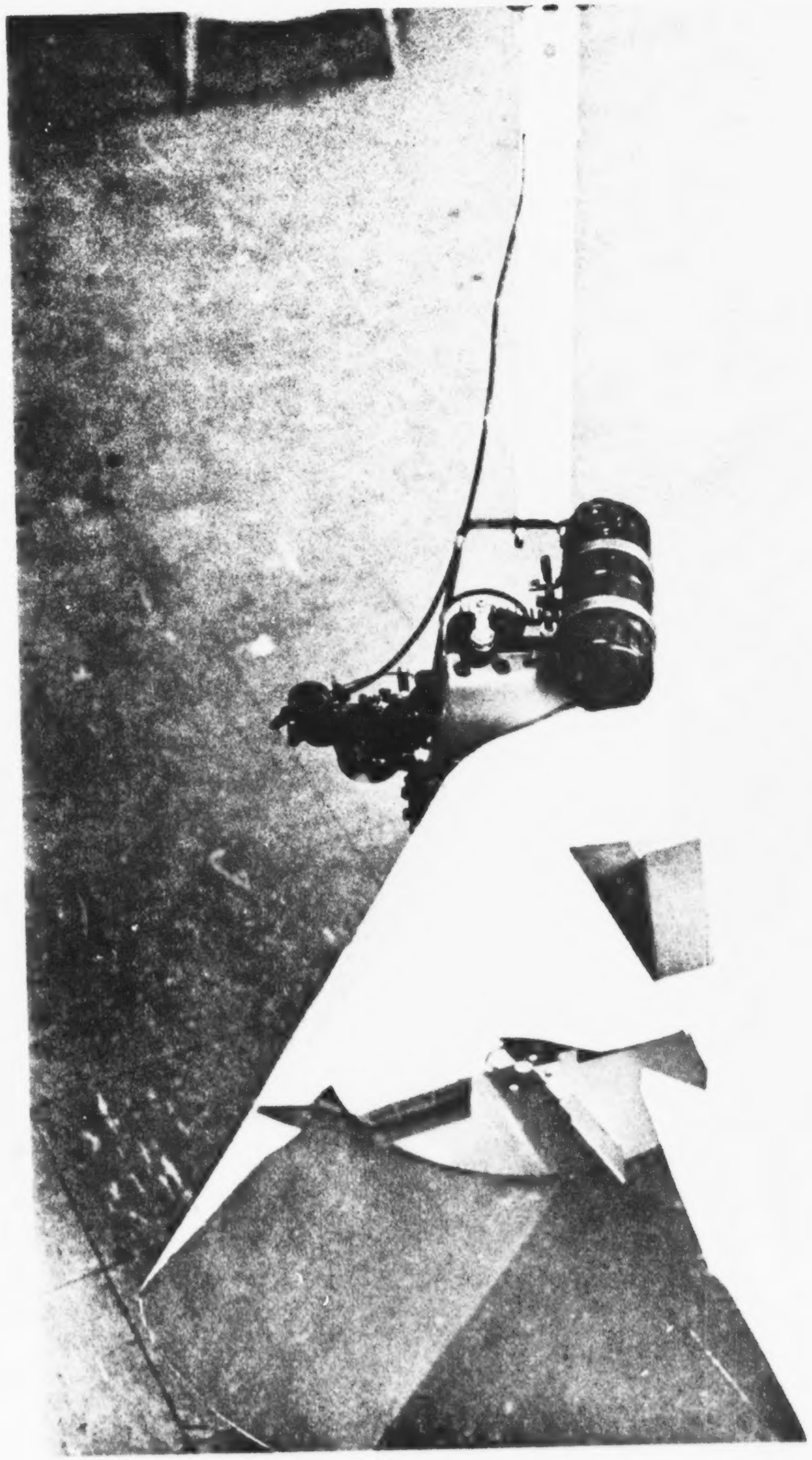


Figure 32.


MACHINING

WELDING



SNOWBLOWER - COMPLETED ASSEMBLY PROJECT

SHEETMETAL

EVALUATION OF CLUSTER CONCEPT PILOT PROGRAMS

Electro-Mechanical Installation and Repair

The electro-mechanical installation and repair cluster was designed to develop within the students, skills and understandings related to the occupations of air conditioning and refrigeration servicemen , business machine serivcemen, home appliance servicemen, and radio and television servicemen . The cluster program is not designed for in-depth development of skills in any one occupation, but aims at preparing students to enter into any of the occupations within the electro-mechanical installation and repair cluster.

The following objectives were emphasized in the curriculum for the electro-mechanical installation and repair cluster:

1. To broaden the student's understanding of the available opportunities in occupations found in the electro-mechanical installation and repair cluster.
2. To develop job entry skills and knowledge for several occupations found in the electro-mechanical installation and repair cluster.
3. To develop a favorable attitude toward work in the electro-mechanical installation and repair cluster.
4. To develop a student's understanding of the sources of information that will be helpful to him as he moves through the occupational areas.

The specific objectives for the course are the following:

1. To develop the student's competency in the use of common hand tools found in the electro-mechanical installation and repair cluster.
2. To develop the student's competency in using power tools and equipment needed for job entry into the occupations found in the electro-mechanical installation and repair cluster.
3. To develop the student's understanding of the operations, procedures, and processes associated with the electro-mechanical installation and repair cluster.
4. To develop safe working habits related to the occupations within the electro-mechanical installation and repair cluster.
5. To familiarize the student with the terminology associated with the electro-mechanical installation and repair cluster.
6. To develop an understanding of the resources available to him in his pursuit of the course as well as in his work following graduation.

Description of the Electro-Mechanical Installation and Repair Cluster Programs

In the following section of the report the pilot program of each school will be discussed with reference to the administration, the teacher, the physical facilities, the instruction, and community involvement.

The information reported was obtained by members of the cluster concept project research team through a series of bi-weekly visitations to the various schools that conducted pilot programs in the electro-mechanical installation and repair cluster.

Orientation. School G was located in an urban setting, although some students were from outlying rural areas. Students in grades 10 through 12 were in attendance. The students could select either the college entrance, business, agriculture, vocational, or general curriculum.

The introduction of the electro-mechanical installation and repair cluster into this school added another dimension to the practical arts curriculum. In addition to the electro-mechanical cluster, the other practical areas of the curriculum included business, home economics, industrial arts, automotives, and agriculture.

The administration. The principal and vice-principal gave consistent support to the cluster concept program and to Teacher G. The administration, including the guidance counselor, was extremely helpful with problems involving scheduling students and class time, and with student enrollment.

The county administration provided little material support for the cluster concept program during the first semester. However, they displayed many other overt acts to promote and to encourage the program. Fortunately, Teacher G was able to conduct phases of his program by utilizing tools and equipment which were on hand for the industrial arts program. In addition, Teacher G was able to procure various appliances and a used typewriter and tape recorder. These items were used for instructional purposes in their respective areas. In the Spring of the year a portion of the requisitioned equipment arrived.

The supervisor of industrial education accompanied the principal investigator and the project coordinator on visitations to the schools in his county involved in the cluster concept program. He also met with the research assistants during their scheduled visitations to School G.

The teacher. Teacher G had a B.S. degree in Industrial Arts and a M.Ed. degree in Vocational Education with eight years of teaching experience in industrial education and seven years of experience in the area of electricity and electronics.

Teacher G was a very resourceful person. He showed great initiative in obtaining free equipment needed for instructional purposes. This equipment was obtained from local industries and businesses and from other schools which had a surplus of certain items.

Physical facilities. In School G, six boys completed the first year's course in the electro-mechanical installation and repair cluster. The enrollment was larger at the start of the year but due to families moving out of town, and other factors beyond the control of the administration, enrollment fell. The class met in the industrial arts laboratory and utilized the equipment and tools in this facility.

At the start of the 1967-1968 school year none of the recommended supplies and equipment were available. A great deal of class time was spent reorganizing the laboratory and providing space for equipment which never arrived. During the year, only about 10 percent of the tools, material, and equipment recommended for this program were recieved.

Teacher G conducted his program by utilizing equipment which was donated by private individuals and business organizations, or brought in by students. Due to the lack of proper equipment only partial instruction in many areas of the cluster was possible.

Teacher G was able to obtain certain pieces of instructional equipment such as a typewriter, an air conditioner, a home freezer, and several radios and television sets. Instruction beyond the basic disassembly and assembly stage was often impossible due to the lack of special tools, materials, and service manuals needed for the repair of this equipment; therefore, complete servicing of these items was not possible. However, toward the end of the year when some test equipment was obtained, much of the theory taught was applied in a practical situation.

A detailed drawing of the laboratory in which the electo-mechanical installation and repair cluster was conducted is shown at the end of this section. See Illustration 9.

Instruction. Student experiences were limited to certain areas of the curriculum due to the lack of equipment and tools. Most of the tasks taught in the area of typewriter repair were taught on a borrowed typewriter for which manuals and special tools were unavailable.

Instruction in the repair of both large and small appliances was conducted using old equipment donated by local businessmen.

Many students obtained experience in the repair of small appliances brought from home or furnished by the home economics department of the school.

Due to the lack of tools and equipment, Teacher G taught his class a great deal of the theory involved in electricity and electronics. Instruction was made as practical as possible by placing the emphasis on the identification of tools and components. Students were taught to identify parts and to understand their function in relation to other components and to the entire appliance under study.

Instruction time was also spent teaching students to interpret wiring diagrams, schematics, and repair manuals. This knowledge was supplemented with as much practical experience as possible, considering the limited amount of tools and equipment available.

In order to evalute the performance of each student enrolled in the electro-mechanical installation and repair cluster, a task inventory was developed. This inventory listed all the tasks to be taught in the electro-mechanical installation and repair cluster. When kept up-to-date, it represented a record of student progress and achievement to teachers, parents, pupils, and in some instances, employers.

The task evaluation charts located at the end of this section are of two types. One list indicates the tasks which were to be taught in the cluster concept program. Those tasks taught this year are indicated by a check (✓). Those tasks which need to be retaught next year are indicated by a double check mark (✓✓). See Figure 33.

The second evaluation chart indicated,in the teacher's opinion, how each student in his class performed the task. Each student received either a satisfactory (S) or unsatisfactory (U) as an evaluation of his achievement. Those tasks not taught during the first year of the pilot program were indicated by the letter (N). See Figure 34.

Community involvement. Community involvement in this program was obtained through the efforts of Teacher G and his students. Various types of large and small appliances were donated by private individuals and members of the business community.

In pursuing their work during the year, Teacher G's class took a field trip to the Victor Products plant in Hagerstown where much of the electro-mechanical work performed paralleled the tasks outlined in the cluster concept curriculum.

A visual summary of the preceding five areas, administration, teacher, physical facilities, instruction, and community involvement, which have been featured in the description of the pilot program at

School G is presented in Figure 35.

Summary and recommendations: The activities and experience gained by the students in School G was limited due to the lack of instructional material, thus, the program suffered. The limited amount of practical experience received by students in this cluster was achieved only by utilizing donated equipment and standard tools.

This program suffered from a lack of tools, materials, and equipment needed for proper instruction. It was recommended that county funds be utilized to supply the additional tools, materials, and equipment which should be on hand for this program when school opens in September, 1968 for the second year of the pilot program.

SCHOOL G

ELECTRO-MECHANICAL INSTALLATION & REPAIR CLUSTER

1. TOOLBOARD
2. METAL LATHE
3. STUDENT LOCKERS
4. WORK BENCH
5. ELECTRICAL TEST BENCH
6. REST ROOM
7. STORAGE CABINET
8. DRILL PRESS
9. GRINDER

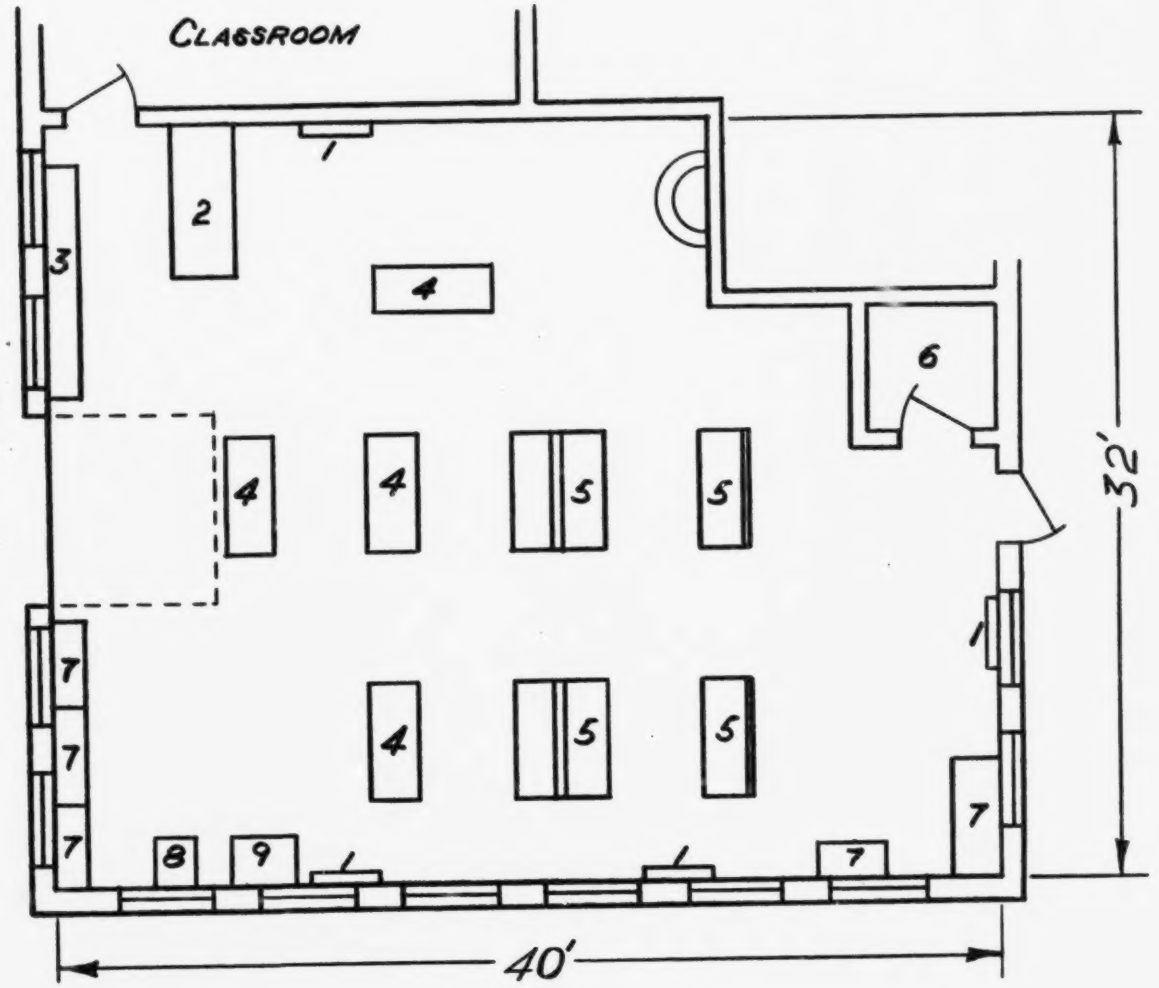

CLASSROOM
1
2
3
4
4
4
4
5
5
5
5
6
7
7
7
7
7
8
9
1
1
1
32'
40'

ILLUSTRATION 9

TASK EVALUATION CHART

Level	Task No.	Task Statement	
		AIR CONDITIONING & REFRIGERATION SERVICING EXPERIENCES	
II	1	Installing tubing between case and condensing unit.	☐
I	2	Testing lines with detection device for leaks	☐
II	3	Installing gages on condensing unit to charge the unit with refrigerant.	☐
I	4	Evacuating the entire system with a vacuum pump to remove all non-condensibles.	☐
I	5	Removing the cover from the unit for ease of servicing.	☑
II	6	Replacing the defective components in the refrigeration unit.	☐
I	7	Replacing the cover on the unit to restore to the original condition.	☑
		BUSINESS MACHINE SERVICING EXPERIENCES	☐
II	1	Observing the symptoms to determine the defects in a typewriter.	☐
I	2	Disassembling the typewriter for cleaning.	☑
I	3	Cleaning typewriter to remove dirt.	☑
II	4	Isolating the mechanical defects to a particular section of the typewriter.	☐
II	5	Isolating the electrical defect(s) to a particular component of the typewriter.	☐
II	6	Isolating the mechanical defect(s) to a particular component of the typewriter.	☐
I	7	Removing the defective part(s) of the typewriter.	☐
II	8	Replacing the defective part(s) of the typewriter.	☐
II	9	Reassembling the repaired typewriter.	☑
II	10	Testing the operation of the repaired typewriter.	☑
II	11	Disassembling the calculator for cleaning.	☐
I	12	Cleaning the calculator to remove dirt.	☐
II	13	Removing the defective part(s) of the calculator.	☐
II	14	Replacing the defective part(s) of the calculator.	☐
II	15	Reassembling the repaired calculator.	☐
II	16	Testing the operation of the repaired calculator.	☐
I	17	Disassembling the adding machine for cleaning.	☐
I	18	Cleaning the adding machine to remove dirt.	☐
II	19	Removing the defective part(s) of the adding machine.	☐
II	20	Replacing the defective part(s) of the adding machine.	☐
II	21	Reassembling the repaired adding machine.	☐
II	22	Testing the operation of the repaired adding machine.	☐
		HOME APPLIANCE SERVICING EXPERIENCES	☐
I	1	Observing the symptoms to determine the defect(s) in small heating element appliances.	☑
I	2	Disassembling small heating element appliances for testing and repairing.	☑
I	3	Isolating the defect to a particular section of the heating element appliance.	☑
I	4	Isolating the defect to a particular component of the heating element appliance.	☑
I	5	Replacing the defective part(s) of small heating element appliances.	☑
I	6	Testing the operations of the repaired small heating element appliance.	☑
I	7	Reassembling the repaired small heating element appliance.	☑
I	8	Retesting the assembled small heating element appliance.	☑
I	9	Observing the symptoms to determine the defect(s) in small motor driven appliances.	☑
I	10	Disassembling small electric motor appliances for testing and repairing	☑

Figure 33.

Level	Task No.	Task Statement	
I	11	Isolating the mechanical defect(s) to a particular section of the small electric motor appliances.	✓
I	12	Isolating the electrical defect(s) to a particular section of the small electric motor appliances.	✓
I	13	Isolating the defect to a particular component of the small electric motor appliance.	✓
I	14	Replacing the defective part(s) of the small electric motor appliances.	✓
I	15	Testing the operation of the repaired small electric motor appliances.	✓
I	16	Reassembling the repaired small electric motor appliance.	✓
I	17	Retesting the repaired small electric motor appliances.	✓
I	18	Connecting the electrical supply to the electric range in the home.	✓
I	19	Checking the installation of the electric range and making any final adjustments necessary.	✓
I	20	Explaining the operation of the electric range to the customer.	✓
I	21	Installing the vent system for the automatic dryer in the home.	
I	22	Connecting the electrical supply to the automatic dryer in the home.	
I	23	Testing the installation of the automatic dryer and making any final adjustments necessary.	
I	24	Explaining the operation of the automatic dryer to the customer.	
I	25	Connecting the water supply to the automatic washer in the home.	
I	26	Connecting the electrical supply to the automatic washer in the home.	
I	27	Checking the installation of the automatic washer and making any final adjustments necessary.	
I	28	Explaining the operation of the automatic washer to the customer.	
I	29	Connecting the electrical supply to the refrigerator in the home.	✓
I	30	Checking the installation of the refrigerator and making any final adjustments necessary.	✓
I	31	Explaining the operation of the refrigerator to the customer.	✓
I	32	Observing the symptoms to determine the defect(s) in an automatic washer.	
I	33	Disassembling the automatic washer in order to make the necessary repair(s).	
II	34	Isolating the electrical defect(s) to a particular section of the automatic washer.	
II	35	Isolating the mechanical defect(s) to a particular section of the automatic washer.	
II	36	Isolating the defect(s) to a particular component in an automatic washer.	
I	37	Replacing the defective part(s) of the automatic washer.	
II	38	Repairing the defective part(s) of the automatic washer.	
II	39	Reassembling the repaired automatic washer.	
II	40	Testing the operation of the automatic washer.	
II	41	Making any final adjustments to the repaired automatic washer.	
I	42	Retesting the assembled automatic washer.	
II	43	Observing the symptoms to determine the defect(s) in an automatic electric dryer.	
II	44	Isolating the electrical defect(s) to a particular section of the automatic electric dryer.	
II	45	Isolating the mechanical defect(s) to a particular section of the automatic electrical dryer.	
I	46	Disassembling the automatic electric dryer in order to make the necessary repair(s).	
II	47	Isolating the defect(s) to a particular component in an automatic electric dryer.	
I	48	Replacing the defective part(s) of the automatic electric dryer.	
II	49	Repairing the defective part(s) of the automatic electric dryer.	
II	50	Reassembling the repaired automatic electric dryer.	

Figure 33, continued

Level	Task No.	Task Statement	
I	51	Testing the operation of the automatic electric dryer.	☐
I	52	Making any final adjustments to the repaired automatic electric dryer.	☐
I	53	Retesting the assembled automatic electric dryer.	☐
II	54	Observing the symptoms to determine the defect(s) in a refrigerator.	☐
I	55	Disassembling the refrigerator in order to make the necessary repair(s).	☐
II	56	Isolating the electrical defect(s) to a particular section of the refrigerator.	☐
II	57	Isolating the mechanical defect(s) to a particular section of the refrigerator.	☐
II	58	Isolating the defect(s) to a particular component in a refrigerator.	☐
I	59	Replacing the defective part(s) of the refrigerator.	☐
II	60	Repairing the defective part(s) of the refrigerator.	☐
II	61	Reassembling the repaired refrigerator.	☐
I	62	Testing the operation of the refrigerator.	☐
I	63	Making any final adjustments to the repaired refrigerator.	☐
I	64	Retesting the assembled refrigerator.	☐
II	65	Observing the symptoms to determine the defect(s) in an electric range.	☑
II	66	Isolating the electrical defect(s) to a particular section of the electric range.	☑
I	67	Disassembling the electric range in order to make the necessary repair(s).	☑
II	68	Isolating the mechanical defect(s) to a particular section of the electric range.	☑
II	69	Isolating the defect(s) to a particular component in an electric range.	☑
I	70	Replacing the defective part(s) of the electric range.	☑
II	71	Repairing the defective part(s) of the electric range.	☑
I	72	Reassembling the repaired electric range.	☑
I	73	Testing the operation of the electric range.	☑
I	74	Making any final adjustments to the repaired electric range.	☑
I	75	Retesting the assembled electric range.	☑

Figure 33, continued

RADIO AND TELEVISION SERVICING EXPERIENCES

Level	Task No.	Task Statement	
I	1	Observing the symptoms to determine the defective stage of the radio.	☐
I	2	Checking the tubes in the suspected defective stage of the radio.	☐
I	3	Removing the chassis from the cabinet for ease of servicing.	☐
II	4	Isolating the defective components in a particular stage of the radio.	☐
I	5	Replacing the defective components in a particular stage of the radio.	☐
I	6	Replacing the chassis in the cabinet after final inspection of the radio.	☐
I	7	Making final operational checks and adjustment to the radio.	☐
I	8	Observing the symptoms to determine the defective stage of the television set.	☑
I	9	Checking the tubes in the suspected stage.	☑
I	10	Removing the chassis from the cabinet for ease of servicing.	☑
II	11	Isolating the defective components in a particular stage of the television set.	☑
I	12	Replacing the defective components in a particular stage of the television set.	☑
I	13	Replacing the chassis in the cabinet after final inspection of the television set.	☑
I	14	Making final operational checks and adjustment to the television set.	☑
II	15	Installing an outdoor television's antenna and transmission line.	☐

TASK EVALUATION CHART

AIR CONDITIONING & REFRIGERATION SERVICING EXPERIENCES

Student

Level	Task No.	Task Statement	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V
II	1	Installing tubing between case and condensing unit.	N	N	N	N	N	N	N															
I	2	Testing lines with detection device for leaks	N	N	N	N	N	N	N															
II	3	Installing gages on condensing unit to charge the unit with refrigerant.	N	N	N	N	N	N	N															
I	4	Evacuating the entire system with a vacuum pump to remove all non-condensibles.	N	N	N	N	N	N	N															
I	5	Removing the cover from the unit for ease of servicing.	S	S	S	S	S	S	S															
II	6	Replacing the defective components in the refrigeration unit.	N	N	N	N	N	N	N															
I	7	Replacing the cover on the unit to restore to the original condition.	S	S	S	S	S	S	S															
		BUSINESS MACHINE SERVICING EXPERIENCES																						
II	1	Observing the symptoms to determine the defects in a typewriter.	N	N	N	N	N	N	N															
I	2	Disassembling the typewriter for cleaning.	S	S	S	S	S	S	S															
I	3	Cleaning typewriter to remove dirt.	S	S	S	S	S	S	S															
II	4	Isolating the mechanical defects to a particular section of the typewriter.	N	N	N	N	N	N	N															
II	5	Isolating the electrical defect(s) to a particular component of the typewriter.	N	N	N	N	N	N	N															
II	6	Isolating the mechanical defect(s) to a particular component of the typewriter.	N	N	N	N	N	N	N															
I	7	Removing the defective part(s) of the typewriter.	N	N	N	N	N	N	N															
II	8	Replacing the defective part(s) of the typewriter.	N	N	N	N	N	N	N															
II	9	Reassembling the repaired typewriter.	S	S	S	S	S	S	S															
II	10	Testing the operation of the repaired typewriter.	S	S	S	S	S	S	S															

Figure 34.

Level	Task No.	Task Statement	Student																					
			A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V
II	11	Disassembling the calculator for cleaning.	N	N	N	N	N	N	N															
I	12	Cleaning the calculator to remove dirt.	N	N	N	N	N	N	N															
II	13	Removing the defective part(s) of the calculator.	N	N	N	N	N	N	N															
II	14	Replacing the defective part(s) of the calculator.	N	N	N	N	N	N	N															
II	15	Reassembling the repaired calculator.	N	N	N	N	N	N	N															
II	16	Testing the operation of the repaired calculator.	N	N	N	N	N	N	N															
I	17	Disassembling the adding machine for cleaning.	N	N	N	N	N	N	N															
I	18	Cleaning the adding machine to remove dirt.	N	N	N	N	N	N	N															
II	19	Removing the defective part(s) of the adding machine.	N	N	N	N	N	N	N															
II	20	Replacing the defective part(s) of the adding machine.	N	N	N	N	N	N	N															
II	21	Reassembling the repaired adding machine.	N	N	N	N	N	N	N															
II	22	Testing the operation of the repaired adding machine.	N	N	N	N	N	N	N															
		HOME APPLIANCE SERVICING EXPERIENCES																						
I	1	Observing the symptoms to determine the defect(s) in small heating element appliances.	S	S	S	S	S	S	S															
I	2	Disassembling small heating element appliances for testing and repairing.	S	S	S	S	S	S	S															
I	3	Isolating the defect to a particular section of the heating element appliance.	S	S	S	S	S	S	S															
I	4	Isolating the defect to a particular component of the heating element appliance.	S	S	S	S	S	S	S															
I	5	Replacing the defective part(s) of small heating element appliances.	S	S	S	S	S	S	S															
I	6	Testing the operations of the repaired small heating element appliance.	S	S	S	S	S	S	S															
I	7	Reassembling the repaired small heating element appliance.	S	S	S	S	S	S	S															
I	8	Retesting the assembled small heating element appliance.	S	S	S	S	S	S	S															
I	9	Observing the symptoms to determine the defect(s) in small motor driven appliances.	S	S	S	S	S	S	S															
I	10	Disassembling small electric motor appliances for testing and repairing.	S	S	S	S	S	S	S															

Figure 34, continued

			Student																					
Level	Task No.	Task Statement	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V
I	11	Isolating the mechanical defect(s) to a particular section of the small electric motor appliances.	S	S	S	S	S	S	S															
I	12	Isolating the electrical defect(s) to a particular section of the small electric motor appliances.	S	S	S	S	S	S	S															
I	13	Isolating the defect to a particular component of the small electric motor appliance.	S	S	S	S	S	S	S															
I	14	Replacing the defective part(s) of the small electric motor appliances.	S	S	S	S	S	S	S															
I	15	Testing the operation of the repaired small electric motor appliances.	S	S	S	S	S	S	S															
I	16	Reassembling the repaired small electric motor appliance.	S	S	S	S	S	S	S															
I	17	Retesting the repaired small electric motor appliances.	S	S	S	S	S	S	S															
I	18	Connecting the electrical supply to the electric range in the home.	S	S	S	S	S	S	S															
I	19	Checking the installation of the electric range and making any final adjustments necessary.	S	S	S	S	S	S	S															
I	20	Explaining the operation of the electric range to the customer.	S	S	S	S	S	S	S															
I	21	Installing the vent system for the automatic dryer in the home.	N	N	N	N	N	N	N															
I	22	Connecting the electrical supply to the automatic dryer in the home.	N	N	N	N	N	N	N															
I	23	Testing the installation of the automatic dryer and making any final adjustments necessary.	N	N	N	N	N	N	N															
I	24	Explaining the operation of the automatic dryer to the customer.	N	N	N	N	N	N	N															
I	25	Connecting the water supply to the automatic washer in the home.	N	N	N	N	N	N	N															
I	26	Connecting the electrical supply to the automatic washer in the home.	N	N	N	N	N	N	N															
I	27	Checking the installation of the automatic washer and making any final adjustments necessary.	N	N	N	N	N	N	N															
I	28	Explaining the operation of the automatic washer to the customer.	N	N	N	N	N	N	N															
I	29	Connecting the electrical supply to the refrigerator in the home.	S	S	S	S	S	S	S															
I	30	Checking the installation of the refrigerator and making any final adjustments necessary.	S	S	S	S	S	S	S															

Figure 34, continued

Level	Task No.	Task Statement	Student																					
			A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V
I	31	Explaining the operation of the refrigerator to the customer.	S	S	S	S	S	S	S															
I	32	Observing the symptoms to determine the defect(s) in an automatic washer.	N	N	N	N	N	N	N															
I	33	Disassembling the automatic washer in order to make the necessary repair(s).	N	N	N	N	N	N	N															
II	34	Isolating the electrical defect(s) to a particular section of the automatic washer.	N	N	N	N	N	N	N															
II	35	Isolating the mechanical defect(s) to a particular section of the automatic washer.	N	N	N	N	N	N	N															
II	36	Isolating the defect(s) to a particular component in an automatic washer.	N	N	N	N	N	N	N															
I	37	Replacing the defective part(s) of the automatic washer.	N	N	N	N	N	N	N															
II	38	Repairing the defective part(s) of the automatic washer.	N	N	N	N	N	N	N															
II	39	Reassembling the repaired automatic washer.	N	N	N	N	N	N	N															
II	40	Testing the operation of the automatic washer.	N	N	N	N	N	N	N															
II	41	Making any final adjustments to the repaired automatic washer.	N	N	N	N	N	N	N															
I	42	Retesting the assembled automatic washer.	N	N	N	N	N	N	N															
II	43	Observing the symptoms to determine the defect(s) in an automatic electric dryer.	N	N	N	N	N	N	N															
II	44	Isolating the electrical defect(s) to a particular section of the automatic electric dryer.	N	N	N	N	N	N	N															
II	45	Isolating the mechanical defect(s) to a particular section of the automatic electrical dryer.	N	N	N	N	N	N	N															
I	46	Disassembling the automatic electric dryer in order to make the necessary repair(s).	N	N	N	N	N	N	N															
II	47	Isolating the defect(s) to a particular component in an automatic electric dryer.	N	N	N	N	N	N	N															
I	48	Replacing the defective part(s) of the automatic electric dryer.	N	N	N	N	N	N	N															
II	49	Repairing the defective part(s) of the automatic electric dryer.	N	N	N	N	N	N	N															
II	50	Reassembling the repaired automatic electric dryer.	N	N	N	N	N	N	N															

Figure 34, continued

Level	Task No.	Task Statement	Student																					
			A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V
I	51	Testing the operation of the automatic electric dryer.	N	N	N	N	N	N	N															
I	52	Making any final adjustments to the repaired automatic electric dryer.	N	N	N	N	N	N	N															
I	53	Retesting the assembled automatic electric dryer.	N	N	N	N	N	N	N															
II	54	Observing the symptoms to determine the defect(s) in a refrigerator.	N	N	N	N	N	N	N															
I	55	Disassembling the refrigerator in order to make the necessary repair(s).	N	N	N	N	N	N	N															
II	56	Isolating the electrical defect(s) to a particular section of the refrigerator.	N	N	N	N	N	N	N															
II	57	Isolating the mechanical defect(s) to a particular section of the refrigerator.	N	N	N	N	N	N	N															
II	58	Isolating the defect(s) to a particular component in a refrigerator.	N	N	N	N	N	N	N															
I	59	Replacing the defective part(s) of the refrigerator.	N	N	N	N	N	N	N															
II	60	Repairing the defective part(s) of the refrigerator.	N	N	N	N	N	N	N															
II	61	Reassembling the repaired refrigerator.	N	N	N	N	N	N	N															
I	62	Testing the operation of the refrigerator.	N	N	N	N	N	N	N															
I	63	Making any final adjustments to the repaired refrigerator.	N	N	N	N	N	N	N															
I	64	Retesting the assembled refrigerator.	N	N	N	N	N	N	N															
II	65	Observing the symptoms to determine the defect(s) in an electric range.	S	S	S	S	S	S	S															
II	66	Isolating the electrical defect(s) to a particular section of the electric range.	S	S	S	S	S	S	S															
I	67	Disassembling the electric range in order to make the necessary repair(s).	S	S	S	S	S	S	S															
II	68	Isolating the mechanical defect(s) to a particular section of the electric range.	S	S	S	S	S	S	S															
II	69	Isolating the defect(s) to a particular component in an electric range.	S	S	S	S	S	S	S															
I	70	Replacing the defective part(s) of the electric range.	S	S	S	S	S	S	S															
II	71	Repairing the defective part(s) of the electric range.	S	S	S	S	S	S	S															
I	72	Reassembling the repaired electric range.	S	S	S	S	S	S	S															
I	73	Testing the operation of the electric range.	S	S	S	S	S	S	S															
I	74	Making any final adjustments to the repaired electric range.	S	S	S	S	S	S	S															
I	75	Retesting the assembled electric range.	S	S	S	S	S	S	S															

Figure 34, continued

RADIO AND TELEVISION SERVICING EXPERIENCES

Level	Task No.	Task Statement	Student																					
			A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V
I	1	Observing the symptoms to determine the defective stage of the radio.	N	N	N	N	N	N	N															
I	2	Checking the tubes in the suspected defective stage of the radio.	N	N	N	N	N	N	N															
I	3	Removing the chassis from the cabinet for ease of servicing.	N	N	N	N	N	N	N															
II	4	Isolating the defective components in a particular stage of the radio.	N	N	N	N	N	N	N															
I	5	Replacing the defective components in a particular stage of the radio.	N	N	N	N	N	N	N															
I	6	Replacing the chassis in the cabinet after final inspection of the radio.	N	N	N	N	N	N	N															
I	7	Making final operational checks and adjustment to the radio.	N	N	N	N	N	N	N															
I	8	Observing the symptoms to determine the defective stage of the television set.	S	S	S	S	S	S	S															
I	9	Checking the tubes in the suspected stage.	S	S	S	S	S	S	S															
I	10	Removing the chassis from the cabinet for ease of servicing.	S	S	S	S	S	S	S															
II	11	Isolating the defective components in a particular stage of the television set.	S	S	S	S	S	S	S															
I	12	Replacing the defective components in a particular stage of the television set.	S	S	S	S	S	S	S															
I	13	Replacing the chassis in the cabinet after final inspection of the television set.	S	S	S	S	S	S	S															
I	14	Making final operational checks and adjustment to the television set.	S	S	S	S	S	S	S															
II	15	Installing an outdoor television's antenna and transmission line.	N	N	N	N	N	N	N															

Figure 34, continued

SUMMARY-EVALUATION OF CLUSTER CONCEPT PILOT PROGRAM

SCHOOL G

	1	2	3	4	5
ADMINISTRATION	The school and county administrative personnel provided minimal moral and material support to the program and the teacher.		The school and county administrative personnel actively supported the program by furnishing the teacher with moral support but with less than satisfactory material support.		The school and county administrative personnel actively supported the program by furnishing the teacher with adequate moral and material support.
TEACHER	Little academic preparation in major field. Little or no teaching experience or practical experience in major field. Seldom shows resourcefulness or initiative.		Adequate academic preparation in major field. Has some teaching experience and some practical experience in major field. Sometime shows resourcefulness and initiative.		Superior academic preparation in major field. An experienced teacher with practical experience in major field. Resourceful. An initiator.
PHYSICAL FACILITIES	The size of the laboratory is inadequate and severely restricts occupational activities. The program also suffers from lack of equipment.		The size of the laboratory is adequate but somewhat restricts occupational activities. The laboratory has the minimum amount of equipment for operating the cluster program.		Size of the laboratory allows unrestricted occupational activities. The laboratory is suitably equipped for the cluster program.
INSTRUCTION	Tasks were taught in only one or two occupations. A very restricted number of Level I tasks were performed by the students. Few experiences offered were appropriate to the cluster.		Tasks were taught in several occupations. A majority of Level I tasks were performed by the students. Experiences were not always appropriate to occupations in the cluster.		Tasks were taught in all occupations. Most Level I tasks were performed by the students. Student experiences were extremely appropriate to occupations in the cluster.
COMMUNITY INVOLVEMENT	Community organizations were unaware of, or did not support the cluster program. Little opportunity for employment was evident in the community.		Community organizations furnished some support to the cluster program. Some members of the class found employment opportunity in the community.		Community organizations cooperated by furnishing aid to the program. A large proportion of the class found employment opportunity in the community.

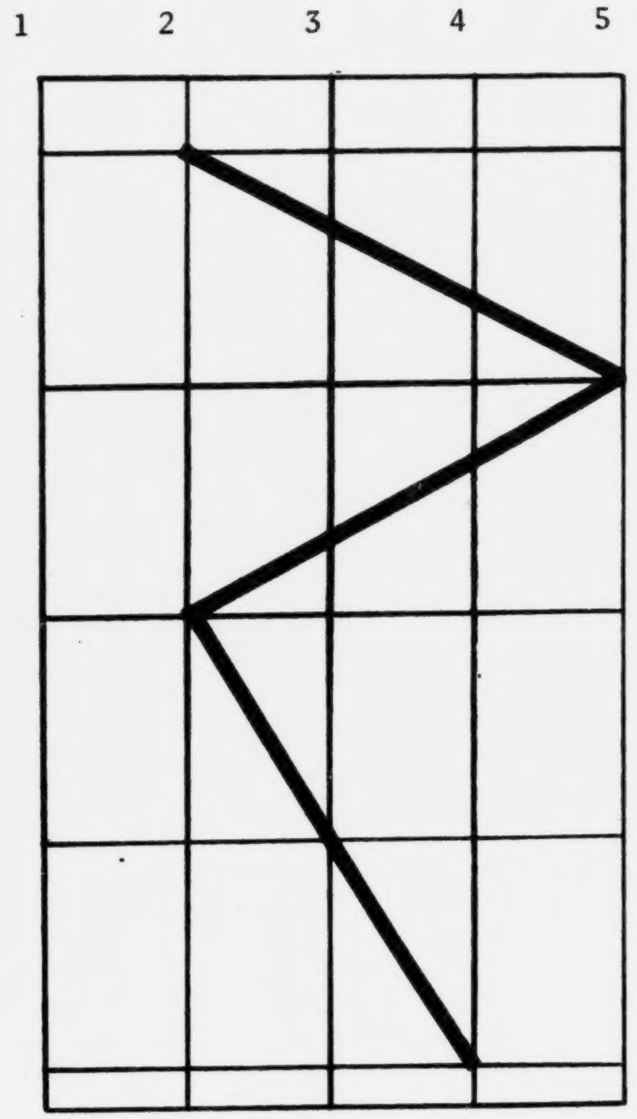


Figure 35.

Orientation. School M was located in an urban setting and was composed of grades 10 through 12. The students could select either the college entrance, business, vocational, or general curriculum.

The introduction of the electro-mechanical installation and repair cluster into this school added another dimension to the practical arts curriculum. In addition to the cluster program, the other areas of the curriculum included courses in business, home economics, industrial arts, carpentry, plumbing and heating, air conditioning and refrigeration, graphic arts, building maintenance, and cosmetology.

The administration. The administration of this particular school, while favoring the idea of the cluster concept program, provided the cluster concept teacher with minimal support. Teacher M was the only one of the ten teachers involved in the cluster program not given a planning period. In addition to teaching five periods of industrial subjects, he was also required to teach one period of mathematics per day. This teaching schedule did not provide Teacher M any time to plan or organize for the following day. In spite of requests from the teacher and members of the cluster concept project research team, this situation was not remedied during the school year.

The county administration provided little material support for the cluster concept program during the first semester, although they were firmly behind the idea. Fortunately, Teacher M was able to conduct the program by utilizing the facilities and equipment of other vocational areas of the school. The activities of the first semester included instruction in air conditioning and refrigeration and home appliance servicing. By utilizing other areas of the school for instruction, the program was not handicapped.

In December, the supervisor of industrial education accompanied the principal investigator and the project coordinator on visitations to the schools in his county involved in cluster concept programs. He also attended several of the scheduled visitations made by members of the research team to School B.

In the middle part of the second semester, Teacher M received equipment and supplies for the area of typewriter repair and was able to begin instruction shortly thereafter.

The teacher. Teacher M's education consisted of a high school diploma and college credits towards certification to teach vocational subjects at the high school level. He had one year of teaching experience in various areas related to the electro-mechanical installation and repair cluster.

Physical facilities. Nine boys were enrolled in the electro-mechanical installation and repair cluster in School M. The size of the laboratory was more than adequate for a class of this size.

Teacher M received approximately 50 percent of the tools, material, and equipment recommended by the cluster concept project research team as necessary to conduct an effective program.

In order to facilitate instruction in the area of typewriter repair, a section of the laboratory designated as a finishing room was converted into an independent classroom for instruction in typewriter repair. Six individual booths (carrels) were constructed, each equipped with a tape recorder, typewriter, and the necessary tools. Thus, each student was able to progress independently at his own speed. This was the only school having an electro-mechanical cluster that had facilities of this type.

A detailed drawing of the laboratory in which the cluster program was conducted is shown at the end of this section. This drawing also indicates major pieces of equipment and shows their location in the laboratory. See illustration 10.

Instruction. The greatest amount of instruction in this particular school took place in the areas of air conditioning and refrigeration and typewriter repair. Experiences in the repair of refrigerators were incorporated with instruction of air conditioning and refrigeration. A limited amount of instruction was given in the areas of large and small appliances while in the areas of radio and television repair it was limited to very basic tasks and performed on surplus equipment, most of which was beyond repair prior to the beginning of instruction.

In order to evaluate the performance of each student enrolled in the electro-mechanical installation and repair cluster,a task inventory was developed. This inventory listed all the tasks to be taught in the electro-mechanical installation and repair cluster. When kept up-to-date, it represented a record of student progress and achievement to teacher, parents, pupils, and in some cases, employers.

The task evaluation charts located at the end of this section are of two types. One list indicates the tasks which were to be taught in the cluster concept program. Those tasks taught this year are indicated by a check (✓). Those tasks which need to be retaught next year are indicated by a double check mark (✓✓). See Figure 36.

The second evaluation chart indicated,in the teacher's opinion, how each student in his class performed the task. Each student received either a satisfactory (S) or unsatisfactory (U) as an evaluation of his achievement. Those tasks not taught during the first year of pilot programs were indicated by the letter (N). See Figure 37.

Community involvement. Teacher M was able to obtain surplus radios, televisions, and large appliances from various repair shops in his community. He also obtained typewriter manuals from local typewriter shops.

Several students obtained employment during the summer within one of the occupations in the cluster.

A visual summary of the preceding five areas, administration, teacher, physical facilities, instruction, and community involvement, which have been featured in the description of the pilot program at School M, is presented in Figure 38.

Summary and recommendations. The students in the electro-mechanical installation and repair cluster at School M received most of their instruction in the area of air conditioning and refrigeration and typewriter repair. Experiences in the other areas of this cluster were limited.

Lack of equipment in the various areas was responsible for part of these limited experiences. Teacher M was fortunate to have been able to use the facilities of the vocational department for instruction in the area of air conditioning and refrigeration. To supplement his own lectures he also enlisted the services of the vocational teacher in this area, thus the class profited by team teaching.

During the summer training sessions Teacher M did not receive sufficient instruction in the various areas of the cluster he was to teach. The lack of a planning period further limited him in developing competency in these areas.

Additional tools, materials, and equipment should be on hand for this program when school opens in September, 1968 for the second year of the pilot program.

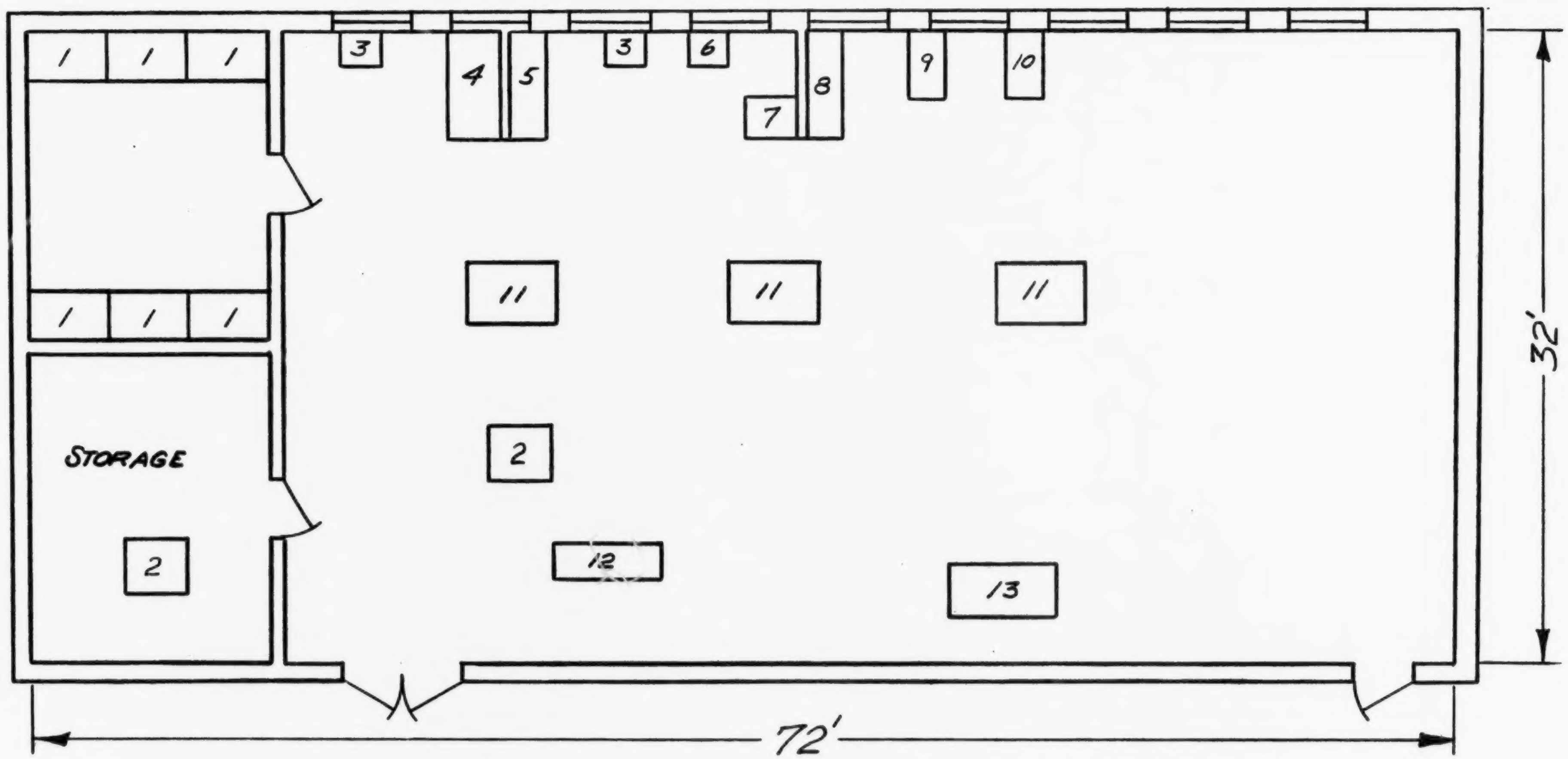
The provision of a free period for the instructor would allow him time for planning and preparation of instructional materials.

A limiting factor in this particular school was Teacher M's lack of teaching experience. Perhaps an instructor with more experience would have had more self-confidence and initiative and would have developed the skills and knowledge he lacked by studying appliance or service manuals on his own time.

The pictures at the end of this section represent typical activities engaged in by students enrolled in the electro-mechanical installation and repair cluster.

SCHOOL M

ELECTRO-MECHANICAL INSTALLATION & REPAIR CLUSTER


1
1
1
1
1
1
STORAGE
2
3
4
5
3
6
7
8
9
10
11
11
11
2
12
13
32'
72'

1. TYPEWRITER REPAIR WORK STATIONS
2. TABLE SAW
3. GRINDER
4. OXY-ACETYLENE WELDING
5. METAL LATHE
6. BUFFER
7. DRILL PRESS
8. WOOD LATHE
9. JIG SAW
10. BAND SAW
11. WORK BENCH
12. JOINTER
13. DESK

ILLUSTRATION 10

TASK EVALUATION CHART

AIR CONDITIONING & REFRIGERATION SERVICING EXPERIENCES

Level	Task No.	Task Statement	
II	1	Installing tubing between case and condensing unit.	✓✓
I	2	Testing lines with detection device for leaks	✓
II	3	Installing gages on condensing unit to charge the unit with refrigerant.	✓✓
I	4	Evacuating the entire system with a vacuum pump to remove all non-condensibles.	☐
I	5	Removing the cover from the unit for ease of servicing.	✓
II	6	Replacing the defective components in the refrigeration unit.	✓✓
I	7	Replacing the cover on the unit to restore to the original condition.	✓

BUSINESS MACHINE SERVICING EXPERIENCES

Level	Task No.	Task Statement	
II	1	Observing the symptoms to determine the defects in a typewriter.	✓
I	2	Disassembling the typewriter for cleaning.	✓✓
I	3	Cleaning typewriter to remove dirt.	✓✓
II	4	Isolating the mechanical defects to a particular section of the typewriter.	✓✓
II	5	Isolating the electrical defect(s) to a particular component of the typewriter.	☐
II	6	Isolating the mechanical defect(s) to a particular component of the typewriter.	✓✓
I	7	Removing the defective part(s) of the typewriter.	✓✓
II	8	Replacing the defective part(s) of the typewriter.	✓✓
II	9	Reassembling the repaired typewriter.	✓✓
II	10	Testing the operation of the repaired typewriter.	✓✓
II	11	Disassembling the calculator for cleaning.	☐
I	12	Cleaning the calculator to remove dirt.	☐
II	13	Removing the defective part(s) of the calculator.	☐
II	14	Replacing the defective part(s) of the calculator.	☐
II	15	Reassembling the repaired calculator.	☐
II	16	Testing the operation of the repaired calculator.	☐
I	17	Disassembling the adding machine for cleaning.	☐
I	18	Cleaning the adding machine to remove dirt.	☐
II	19	Removing the defective part(s) of the adding machine.	☐
II	20	Replacing the defective part(s) of the adding machine.	☐
II	21	Reassembling the repaired adding machine.	☐
II	22	Testing the operation of the repaired adding machine.	☐

HOME APPLIANCE SERVICING EXPERIENCES

Level	Task No.	Task Statement	
I	1	Observing the symptoms to determine the defect(s) in small heating element appliances.	✓✓
I	2	Disassembling small heating element appliances for testing and repairing.	☐
I	3	Isolating the defect to a particular section of the heating element appliance.	☐
I	4	Isolating the defect to a particular component of the heating element appliance.	☐
I	5	Replacing the defective part(s) of small heating element appliances.	☐
I	6	Testing the operations of the repaired small heating element appliance.	☐
I	7	Reassembling the repaired small heating element appliance.	☐
I	8	Retesting the assembled small heating element appliance.	☐
I	9	Observing the symptoms to determine the defect(s) in small motor driven appliances.	☐
I	10	Disassembling small electric motor appliances for testing and repairing.	☐

Figure 36.

Level	Task No.	Task Statement	
I	11	Isolating the mechanical defect(s) to a particular section of the small electric motor appliances.	✓✓
I	12	Isolating the electrical defect(s) to a particular section of the small electric motor appliances.	✓✓
I	13	Isolating the defect to a particular component of the small electric motor appliance.	✓✓
I	14	Replacing the defective part(s) of the small electric motor appliances.	✓✓
I	15	Testing the operation of the repaired small electric motor appliances.	✓✓
I	16	Reassembling the repaired small electric motor appliance.	✓✓
I	17	Retesting the repaired small electric motor appliances.	✓✓
I	18	Connecting the electrical supply to the electric range in the home.	
I	19	Checking the installation of the electric range and making any final adjustments necessary.	
I	20	Explaining the operation of the electric range to the customer.	
I	21	Installing the vent system for the automatic dryer in the home.	
I	22	Connecting the electrical supply to the automatic dryer in the home.	
I	23	Testing the installation of the automatic dryer and making any final adjustments necessary.	
I	24	Explaining the operation of the automatic dryer to the customer.	
I	25	Connecting the water supply to the automatic washer in the home.	
I	26	Connecting the electrical supply to the automatic washer in the home.	
I	27	Checking the installation of the automatic washer and making any final adjustments necessary.	
I	28	Explaining the operation of the automatic washer to the customer.	
I	29	Connecting the electrical supply to the refrigerator in the home.	
I	30	Checking the installation of the refrigerator and making any final adjustments necessary.	
I	31	Explaining the operation of the refrigerator to the customer.	✓
I	32	Observing the symptoms to determine the defect(s) in an automatic washer.	✓
I	33	Disassembling the automatic washer in order to make the necessary repair(s).	✓
II	34	Isolating the electrical defect(s) to a particular section of the automatic washer.	
II	35	Isolating the mechanical defect(s) to a particular section of the automatic washer.	✓✓
II	36	Isolating the defect(s) to a particular component in an automatic washer.	✓✓
I	37	Replacing the defective part(s) of the automatic washer.	✓✓
II	38	Repairing the defective part(s) of the automatic washer.	✓✓
II	39	Reassembling the repaired automatic washer.	✓✓
II	40	Testing the operation of the automatic washer.	
II	41	Making any final adjustments to the repaired automatic washer.	
I	42	Retesting the assembled automatic washer.	
II	43	Observing the symptoms to determine the defect(s) in an automatic electric dryer.	
II	44	Isolating the electrical defect(s) to a particular section of the automatic electric dryer.	
II	45	Isolating the mechanical defect(s) to a particular section of the automatic electrical dryer.	
I	46	Disassembling the automatic electric dryer in order to make the necessary repair(s).	
II	47	Isolating the defect(s) to a particular component in an automatic electric dryer.	
I	48	Replacing the defective part(s) of the automatic electric dryer.	
II	49	Repairing the defective part(s) of the automatic electric dryer.	
II	50	Reassembling the repaired automatic electric dryer.	

Figure 36, continued

Level	Task No.	Task Statement	
I	51	Testing the operation of the automatic electric dryer.	☐
I	52	Making any final adjustments to the repaired automatic electric dryer.	☐
I	53	Retesting the assembled automatic electric dryer.	☐
II	54	Observing the symptoms to determine the defect(s) in a refrigerator.	✓
I	55	Disassembling the refrigerator in order to make the necessary repair(s).	✓✓
II	56	Isolating the electrical defect(s) to a particular section of the refrigerator.	✓✓
II	57	Isolating the mechanical defect(s) to a particular section of the refrigerator.	✓✓
II	58	Isolating the defect(s) to a particular component in a refrigerator.	✓✓
I	59	Replacing the defective part(s) of the refrigerator.	✓✓
II	60	Repairing the defective part(s) of the refrigerator.	✓✓
II	61	Reassembling the repaired refrigerator.	✓✓
I	62	Testing the operation of the refrigerator.	✓✓
I	63	Making any final adjustments to the repaired refrigerator.	☐
I	64	Retesting the assembled refrigerator.	☐
II	65	Observing the symptoms to determine the defect(s) in an electric range.	☐
II	66	Isolating the electrical defect(s) to a particular section of the electric range.	☐
I	67	Disassembling the electric range in order to make the necessary repair(s).	☐
II	68	Isolating the mechanical defect(s) to a particular section of the electric range.	☐
II	69	Isolating the defect(s) to a particular component in an electric range.	☐
I	70	Replacing the defective part(s) of the electric range.	☐
II	71	Repairing the defective part(s) of the electric range.	☐
I	72	Reassembling the repaired electric range.	☐
I	73	Testing the operation of the electric range.	☐
I	74	Making any final adjustments to the repaired electric range.	☐
I	75	Retesting the assembled electric range.	☐

Figure 36, continued

RADIO AND TELEVISION SERVICING EXPERIENCES

Level	Task No.	Task Statement	
I	1	Observing the symptoms to determine the defective stage of the radio.	✓
I	2	Checking the tubes in the suspected defective stage of the radio.	✓
I	3	Removing the chassis from the cabinet for ease of servicing.	✓
II	4	Isolating the defective components in a particular stage of the radio.	☐
I	5	Replacing the defective components in a particular stage of the radio.	☐
I	6	Replacing the chassis in the cabinet after final inspection of the radio.	✓
I	7	Making final operational checks and adjustment to the radio.	☐
I	8	Observing the symptoms to determine the defective stage of the television set.	☐
I	9	Checking the tubes in the suspected stage.	✓
I	10	Removing the chassis from the cabinet for ease of servicing.	✓
II	11	Isolating the defective components in a particular stage of the television set.	☐
I	12	Replacing the defective components in a particular stage of the television set.	☐
I	13	Replacing the chassis in the cabinet after final inspection of the television set.	✓
I	14	Making final operational checks and adjustment to the television set.	☐
II	15	Installing an outdoor television's antenna and transmission line.	☐

TASK EVALUATION CHART

AIR CONDITIONING & REFRIGERATION SERVICING EXPERIENCES

Student

Level	Task No.	Task Statement	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V
II	1	Installing tubing between case and condensing unit.	S	S	U	S	S	U	S	S	U													
I	2	Testing lines with detection device for leaks	S	S	S	S	S	S	S	S	S													
II	3	Installing gages on condensing unit to charge the unit with refrigerant.	U	U	U	S	U	U	S	S	U													
I	4.	Evacuating the entire system with a vacuum pump to remove all non-condensibles.	N	N	N	N	N	N	N	N	N													
I	5	Removing the cover from the unit for ease of servicing.	S	S	S	S	S	S	S	U	S													
II	6	Replacing the defective components in the refrigeration unit.	S	S	S	S	S	S	S	U	U													
I	7	Replacing the cover on the unit to restore to the original condition.	S	S	S	S	S	S	S	U	S													
		BUSINESS MACHINE SERVICING EXPERIENCES																						
II	1	Observing the symptoms to determine the defects in a typewriter.	S	S	S	S	S	S	S	S	U													
I	2	Disassembling the typewriter for cleaning.	S	S	U	S	S	U	S	U	U													
I	3	Cleaning typewriter to remove dirt.	S	S	S	S	S	S	S	U	U													
II	4	Isolating the mechanical defects to a particular section of the typewriter.	S	S	U	S	S	U	S	U	U													
II	5	Isolating the electrical defect(s) to a particular component of the typewriter.	N	N	N	N	N	N	N	N	N													
II	6	Isolating the mechanical defect(s) to a particular component of the typewriter.	S	S	U	S	S	U	S	U	U													
I	7	Removing the defective part(s) of the typewriter.	S	S	S	S	S	S	S	U	U													
II	8	Replacing the defective part(s) of the typewriter.	U	U	U	S	S	U	S	U	U													
II	9	Reassembling the repaired typewriter.	U	U	U	S	S	U	S	U	U													
II	10	Testing the operation of the repaired typewriter.	S	S	S	S	S	S	S	U	U													

Figure 37.

			Student																					
Level	Task No.	Task Statement	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V
II	11	Disassembling the calculator for cleaning.	N	N	N	N	N	N	N	N	N													
I	12	Cleaning the calculator to remove dirt.	N	N	N	N	N	N	N	N	N													
II	13	Removing the defective part(s) of the calculator.	N	N	N	N	N	N	N	N	N													
II	14	Replacing the defective part(s) of the calculator.	N	N	N	N	N	N	N	N	N													
II	15	Reassembling the repaired calculator.	N	N	N	N	N	N	N	N	N													
II	16	Testing the operation of the repaired calculator.	N	N	N	N	N	N	N	N	N													
I	17	Disassembling the adding machine for cleaning.	N	N	N	N	N	N	N	N	N													
I	18	Cleaning the adding machine to remove dirt.	N	N	N	N	N	N	N	N	N													
II	19	Removing the defective part(s) of the adding machine.	N	N	N	N	N	N	N	N	N													
II	20	Replacing the defective part(s) of the adding machine.	N	N	N	N	N	N	N	N	N													
II	21	Reassembling the repaired adding machine.	N	N	N	N	N	N	N	N	N													
II	22	Testing the operation of the repaired adding machine.	N	N	N	N	N	N	N	N	N													
		HOME APPLIANCE SERVICING EXPERIENCES																						
I	1	Observing the symptoms to determine the defect(s) in small heating element appliances.	S	S	U	S	S	U	S	S	S													
I	2	Disassembling small heating element appliances for testing and repairing.	N	N	N	N	N	N	N	N	N													
I	3	Isolating the defect to a particular section of the heating element appliance.	N	N	N	N	N	N	N	N	N													
I	4	Isolating the defect to a particular component of the heating element appliance.	N	N	N	N	N	N	N	N	N													
I	5	Replacing the defective part(s) of small heating element appliances.	N	N	N	N	N	N	N	N	N													
I	6	Testing the operations of the repaired small heating element appliance.	N	N	N	N	N	N	N	N	N													
I	7	Reassembling the repaired small heating element appliance.	N	N	N	N	N	N	N	N	N													
I	8	Retesting the assembled small heating element appliance.	N	N	N	N	N	N	N	N	N													
I	9	Observing the symptoms to determine the defect(s) in small motor driven appliances.	N	N	N	N	N	N	N	N	N													
I	10	Disassembling small electric motor appliances for testing and repairing.	N	N	N	N	N	N	N	N	N													

Figure 37, continued

			Student																					
Level	Task No.	Task Statement	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V
I	11	Isolating the mechanical defect(s) to a particular section of the small electric motor appliances.	S	S	S	S	S	S	S	U	U													
I	12	Isolating the electrical defect(s) to a particular section of the small electric motor appliances.	S	S	U	S	S	U	S	U	U													
I	13	Isolating the defect to a particular component of the small electric motor appliance.	S	S	U	S	S	U	S	U	U													
I	14	Replacing the defective part(s) of the small electric motor appliances.	S	S	U	S	S	U	S	U	U													
I	15	Testing the operation of the repaired small electric motor appliances.	S	S	S	S	S	S	S	U	U													
I	16	Reassembling the repaired small electric motor appliance.	S	S	U	S	S	U	S	U	U													
I	17	Retesting the repaired small electric motor appliances.	S	S	S	S	S	S	S	U	U													
I	18	Connecting the electrical supply to the electric range in the home.	N	N	N	N	N	N	N	N	N													
I	19	Checking the installation of the electric range and making any final adjustments necessary.	N	N	N	N	N	N	N	N	N													
I	20	Explaining the operation of the electric range to the customer.	N	N	N	N	N	N	N	N	N													
I	21	Installing the vent system for the automatic dryer in the home.	N	N	N	N	N	N	N	N	N													
I	22	Connecting the electrical supply to the automatic dryer in the home.	N	N	N	N	N	N	N	N	N													
I	23	Testing the installation of the automatic dryer and making any final adjustments necessary.	N	N	N	N	N	N	N	N	N													
I	24	Explaining the operation of the automatic dryer to the customer.	N	N	N	N	N	N	N	N	N													
I	25	Connecting the water supply to the automatic washer in the home.	N	N	N	N	N	N	N	N	N													
I	26	Connecting the electrical supply to the automatic washer in the home.	N	N	N	N	N	N	N	N	N													
I	27	Checking the installation of the automatic washer and making any final adjustments necessary.	N	N	N	N	N	N	N	N	N													
I	28	Explaining the operation of the automatic washer to the customer.	N	N	N	N	N	N	N	N	N													
I	29	Connecting the electrical supply to the refrigerator in the home.	N	N	N	N	N	N	N	N	N													
I	30	Checking the installation of the refrigerator and making any final adjustments necessary.	N	N	N	N	N	N	N	N	N													

Figure 37, continued

Student

Level	Task No.	Task Statement	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V
I	31	Explaining the operation of the refrigerator to the customer.	S	S	S	S	S	U	S	S	S													
I	32	Observing the symptoms to determine the defect(s) in an automatic washer.	S	S	S	S	S	S	S	S	S													
I	33	Disassembling the automatic washer in order to make the necessary repair(s).	S	S	S	S	S	S	S	S	S													
II	34	Isolating the electrical defect(s) to a particular section of the automatic washer.	N	N	N	N	N	N	N	N	N													
II	35	Isolating the mechanical defect(s) to a particular section of the automatic washer.	S	S	S	S	S	U	S	U	U													
II	36	Isolating the defecc(s) to a particular component in an automatic washer.	S	S	U	S	S	U	S	U	U													
I	37	Replacing the defective part(s) of the automatic washer.	S	S	U	S	S	U	S	U	U													
II	38	Repairing the defective part(s) of the automatic washer.	S	S	U	S	S	U	S	U	U													
II	39	Reassembling the repaired automatic washer.	S	S	S	S	S	S	S	U	U													
II	40	Testing the operation of the automatic washer.	N	N	N	N	N	N	N	N	N													
II	41	Making any final adjustments to the repaired automatic washer.	N	N	N	N	N	N	N	N	N													
I	42	Retesting the assembled automatic washer.	N	N	N	N	N	N	N	N	N													
II	43	Observing the symptoms to determine the defect(s) in an automatic electric dryer.	N	N	N	N	N	N	N	N	N													
II	44	Isolating the electrical defect(s) to a particular section of the automatic electric dryer.	N	N	N	N	N	N	N	N	N													
II	45	Isolating the mechanical defect(s) to a particular section of the automatic electrical dryer.	N	N	N	N	N	N	N	N	N													
I	46	Disassembling the automatic electric dryer in order to make the necessary repair(s).	N	N	N	N	N	N	N	N	N													
II	47	Isolating the defect(s) to a particular component in an automatic electric dryer.	N	N	N	N	N	N	N	N	N													
I	48	Replacing the defective part(s) of the automatic electric dryer.	N	N	N	N	N	N	N	N	N													
II	49	Repairing the defective part(s) of the automatic electric dryer.	N	N	N	N	N	N	N	N	N													
II	50	Reassembling the repaired automatic electric dryer.	N	N	N	N	N	N	N	N	N													

Figure 37, continued

			Student																					
Level	Task No.	Task Statement	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V
I	51	Testing the operation of the automatic electric dryer.	N	N	N	N	N	N	N	N	N													
I	52	Making any final adjustments to the repaired automatic electric dryer.	N	N	N	N	N	N	N	N	N													
I	53	Retesting the assembled automatic electric dryer.	N	N	N	N	N	N	N	N	N													
II	54	Observing the symptoms to determine the defect(s) in a refrigerator.	S	S	S	S	S	S	S	S	S													
I	55	Disassembling the refrigerator in order to make the necessary repair(s).	S	S	S	S	S	S	S	U	U													
II	56	Isolating the electrical defect(s) to a particular section of the refrigerator.	S	S	S	S	S	U	S	U	U													
II	57	Isolating the mechanical defect(s) to a particular section of the refrigerator.	S	S	S	S	S	U	S	U	U													
II	58	Isolating the defect(s) to a particular component in a refrigerator.	S	S	S	S	S	U	S	U	U													
I	59	Replacing the defective part(s) of the refrigerator.	S	S	S	S	S	U	S	U	U													
II	60	Repairing the defective part(s) of the refrigerator.	S	S	S	S	S	U	S	U	U													
II	61	Reassembling the repaired refrigerator.	S	S	S	S	S	U	S	U	U													
I	62	Testing the operation of the refrigerator.	S	S	S	S	S	U	S	U	U													
I	63	Making any final adjustments to the repaired refrigerator.	N	N	N	N	N	N	N	N	N													
I	64	Retesting the assembled refrigerator.	N	N	N	N	N	N	N	N	N													
II	65	Observing the symptoms to determine the defect(s) in an electric range.	N	N	N	N	N	N	N	N	N													
II	66	Isolating the electrical defect(s) to a particular section of the electric range.	N	N	N	N	N	N	N	N	N													
I	67	Disassembling the electric range in order to make the necessary repair(s).	N	N	N	N	N	N	N	N	N													
II	68	Isolating the mechanical defect(s) to a particular section of the electric range.	N	N	N	N	N	N	N	N	N													
II	69	Isolating the defect(s) to a particular component in an electric range.	N	N	N	N	N	N	N	N	N													
I	70	Replacing the defective part(s) of the electric range.	N	N	N	N	N	N	N	N	N													
II	71	Repairing the defective part(s) of the electric range.	N	N	N	N	N	N	N	N	N													
I	72	Reassembling the repaired electric range.	N	N	N	N	N	N	N	N	N													
I	73	Testing the operation of the electric range.	N	N	N	N	N	N	N	N	N													
I	74	Making any final adjustments to the repaired electric range.	N	N	N	N	N	N	N	N	N													
I	75	Retesting the assembled electric range.	N	N	N	N	N	N	N	N	N													

Figure 37, continued

RADIO AND TELEVISION SERVICING EXPERIENCES

			Student																					
Level	Task No.	Task Statement	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V
I	1	Observing the symptoms to determine the defective stage of the radio.	S	S	S	S	S	S	S	S	S													
I	2	Checking the tubes in the suspected defective stage of the radio.	S	S	S	S	S	S	S	S	S													
I	3	Removing the chassis from the cabinet for ease of servicing.	S	S	S	S	S	S	S	S	S													
II	4	Isolating the defective components in a particular stage of the radio.	N	N	N	N	N	N	N	N	N													
I	5	Replacing the defective components in a particular stage of the radio.	N	N	N	N	N	N	N	N	N													
I	6	Replacing the chassis in the cabinet after final inspection of the radio.	S	S	U	S	S	U	S	S	S													
I	7	Making final operational checks and adjustment to the radio.	N	N	N	N	N	N	N	N	N													
I	8	Observing the symptoms to determine the defective stage of the television set.	N	N	N	N	N	N	N	N	N													
I	9	Checking the tubes in the suspected stage.	S	S	S	S	S	S	S	S	S													
I	10	Removing the chassis from the cabinet for ease of servicing.	S	S	S	S	S	S	S	S	S													
II	11	Isolating the defective components in a particular stage of the television set.	N	N	N	N	N	N	N	N	N													
I	12	Replacing the defective components in a particular stage of the television set.	N	N	N	N	N	N	N	N	N													
I	13	Replacing the chassis in the cabinet after final inspection of the television set.	S	S	S	S	S	S	S	S	S													
I	14	Making final operational checks and adjustment to the television set.	N	N	N	N	N	N	N	N	N													
II	15	Installing an outdoor television's antenna and transmission line.	N	N	N	N	N	N	N	N	N													

Figure 37, continued

SUMMARY-EVALUATION OF CLUSTER CONCEPT PILOT PROGRAM

SCHOOL M

	1	2	3	4	5
ADMINISTRATION	The school and county administrative personnel provided minimal moral and material support to the program and the teacher.		The school and county administrative personnel actively supported the program by furnishing the teacher with moral support but with less than satisfactory material support.		The school and county administrative personnel actively supported the program by furnishing the teacher with adequate moral and material support.
TEACHER	Little academic preparation in major field. Little or no teaching experience or practical experience in major field. Seldom shows resourcefulness or initiative.		Adequate academic preparation in major field. Has some teaching experience and some practical experience in major field. Sometime shows resourcefulness and initiative.		Superior academic preparation in major field. An experienced teacher with practical experience in major field. Resourceful. An initiator.
PHYSICAL FACILITIES	The size of the laboratory is inadequate and severely restricts occupational activities. The program also suffers from lack of equipment.		The size of the laboratory is adequate but somewhat restricts occupational activities. The laboratory has the minimum amount of equipment for operating the cluster program.		Size of the laboratory allows unrestricted occupational activities. The laboratory is suitably equipped for the cluster program.
INSTRUCTION	Tasks were taught in only one or two occupations. A very restricted number of Level I tasks were performed by the students. Few experiences offered were appropriate to the cluster.		Tasks were taught in several occupations. A majority of Level I tasks were performed by the students. Experiences were not always appropriate to occupations in the cluster.		Tasks were taught in all occupations. Most Level I tasks were performed by the students. Student experiences were extremely appropriate to occupations in the cluster.
COMMUNITY INVOLVEMENT	Community organizations were unaware of, or did not support the cluster program. Little opportunity for employment was evident in the community.		Community organizations furnished some support to the cluster program. Some members of the class found employment opportunity in the community.		Community organizations cooperated by furnishing aid to the program. A large proportion of the class found employment opportunity in the community.

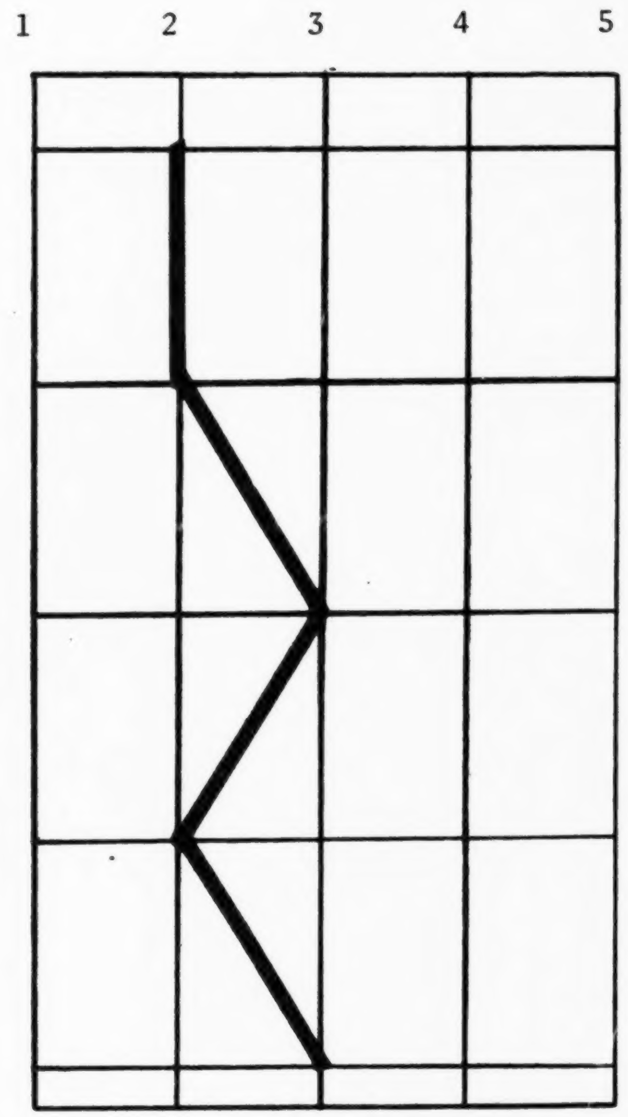
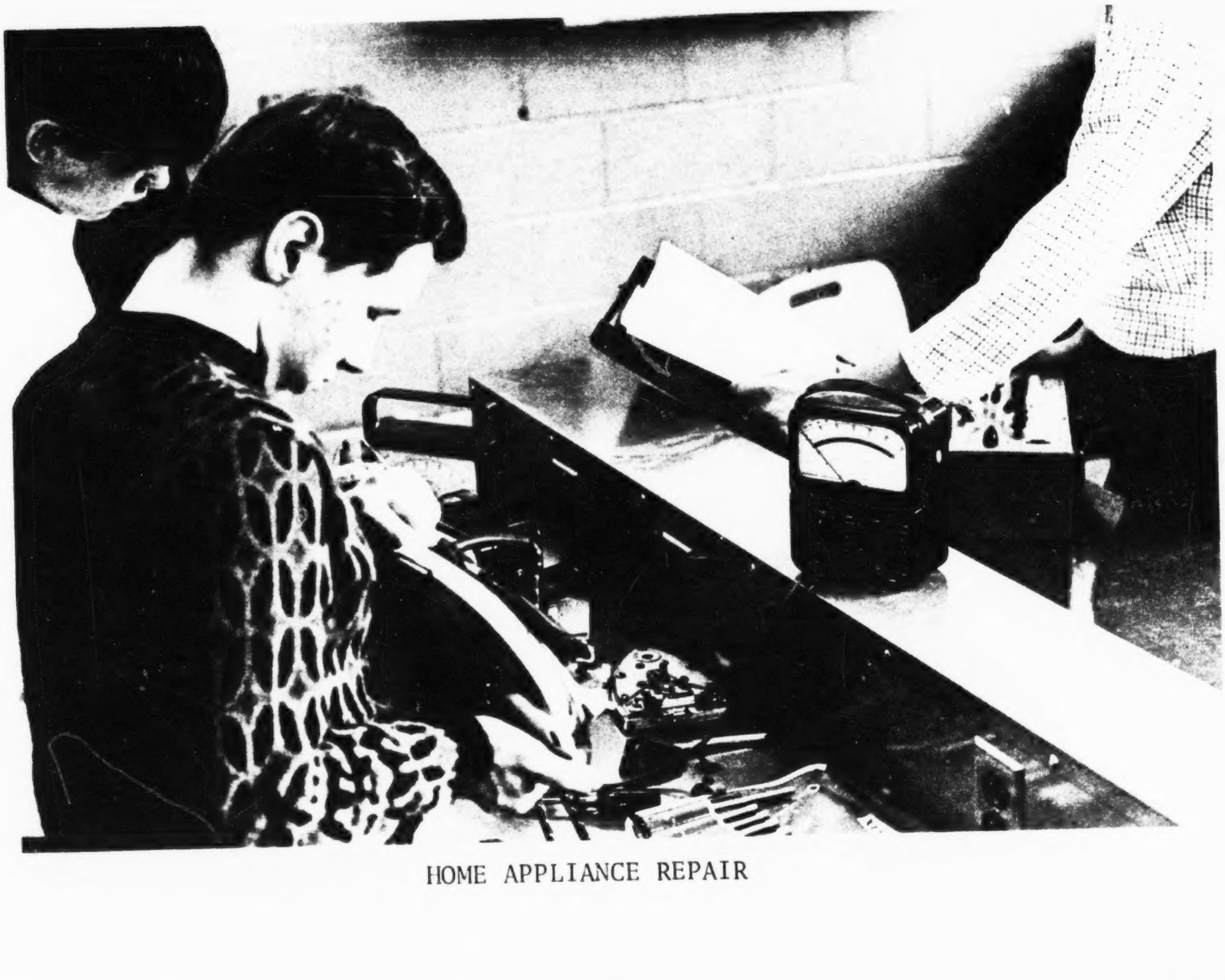
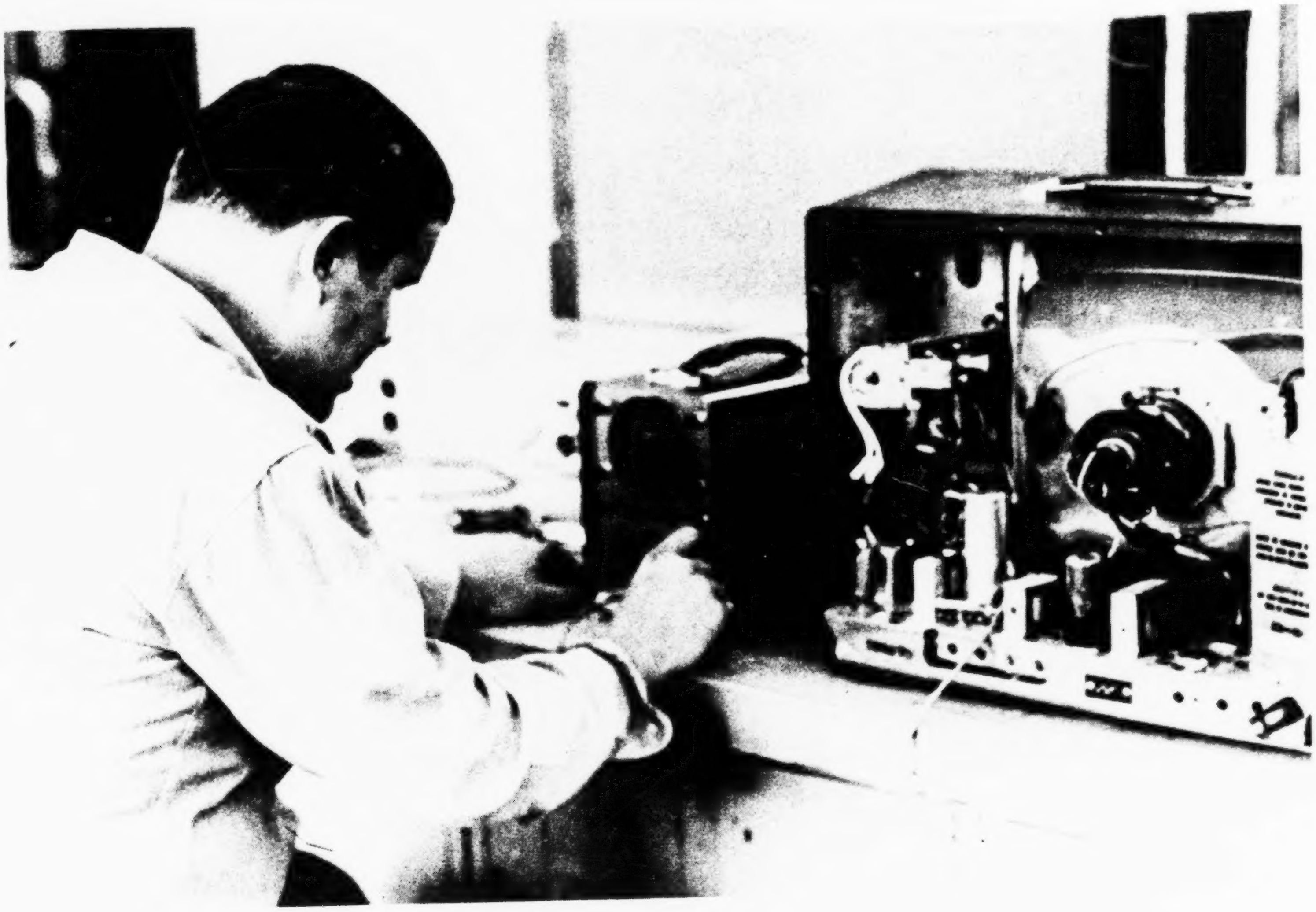


Figure 38.

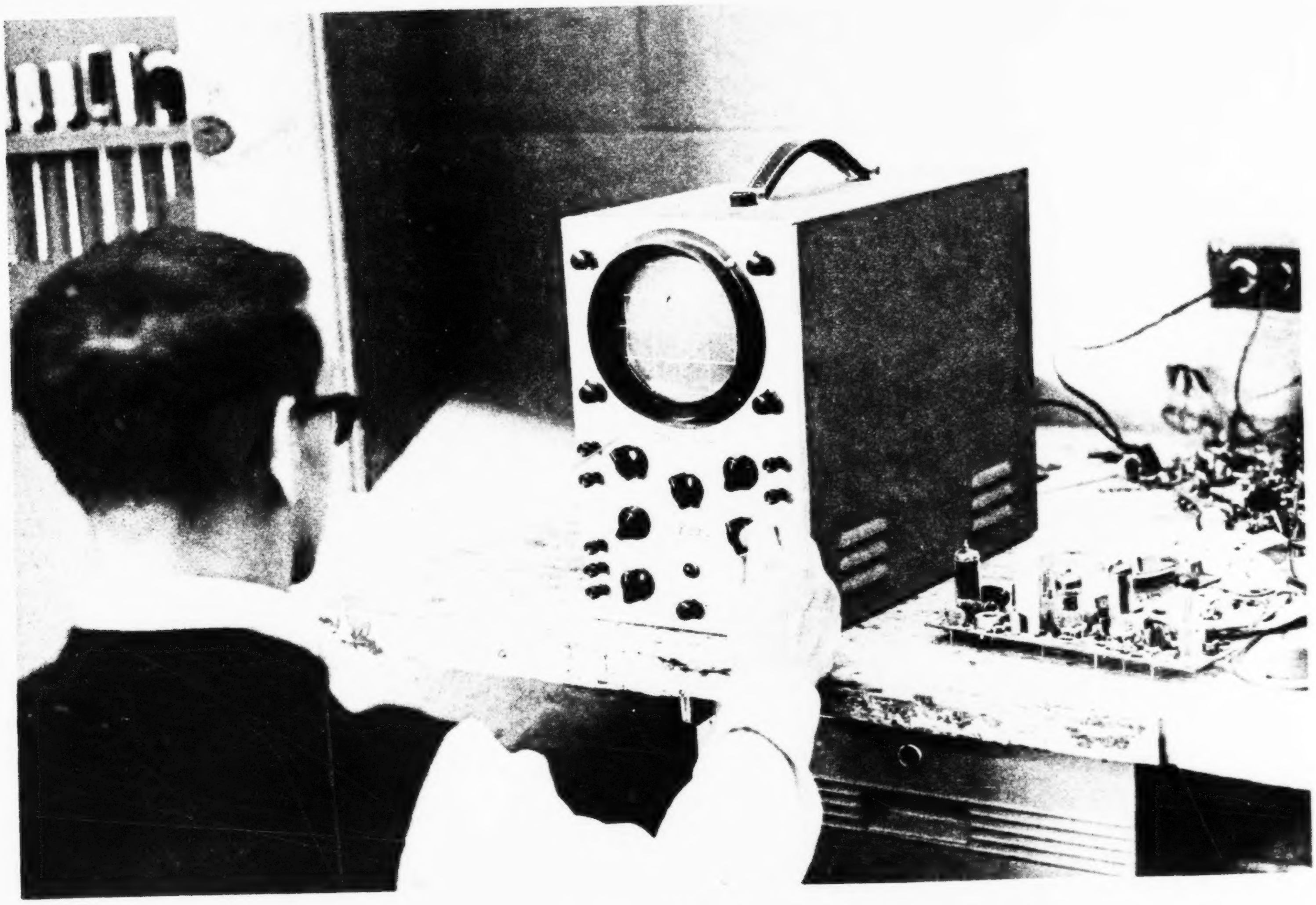
TYPEWRITER REPAIR



HOME APPLIANCE REPAIR



TELEVISION REPAIR



RADIO REPAIR

PART IV

SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

Introduction

The cluster concept, as structured, was aimed at the preparation of individuals for entry level capability in a variety of related rather than specific occupations. It was based on the premise that educational experiences with a range of related occupations appear defensible for most students who have no realistic basis for decision making when selecting a specific vocation or trade. The program was designed to enhance the individual's potential employability by virtue of offering a wide range of entrance skills and a level of articulation across several occupational fields. It was believed that this type of fundamental training would enable the individual to move back and forth over several occupational categories as well as vertically within a specific occupation. It was also believed that the program would provide secondary students with a greater degree of flexibility for vocational decision making rather than compelling them to make a commitment to study within a "one-goal directed" traditional program.

This report is a summary of the third phase of research with the cluster concept program. The first phase of the research established the acceptability and feasibility of cluster programs and curricula for the occupational clusters of construction, metal forming and fabrication, and electro-mechanical installation and repair. The completion of phase II resulted in the production of curriculum guides, course outlines, instructional materials and the selection and training of the necessary teachers to implement the programs in secondary schools of four counties in the State of Maryland. Phase III is considered within this report. It is an evaluation of the first year of experimentation and implementation of the cluster programs at the eleventh-grade level. Only upon completion of the fourth phase will the total effect of the new program be observed and evaluated. It was anticipated that the fourth year of research would be supported through the authorization of the Bureau of Research under the provisions of Section 4c of the 1963 Vocational Education Act.

Research Summary of Phase Three

This research was characterized as being "aexperimental"[1] where several variables in a field situation were investigated. As such, it was designed to generate several types of data for the purpose of evaluating the cluster concept programs while they were implemented in the field. Descriptive, comparative, and quantitative data were used to assess the impact of the first year of the program on the student, teacher, administration, and the adequacy of the instructional materials.

Problems

The problems investigated were those which provided evidence of the effectiveness of the cluster concept programs of studies in a field setting. The three principal areas of investigation included the determination of:

---

[1] Egon G. Guba,"Methodological Strategies for Educational Change," Paper presented to the Conference on Strategies for Educational Change, Washington, D.C., November 8-10, 1965, Columbus: School of Education, Ohio State University, 1965, 38 pp.

1. The impact of the cluster concept program on selected cognitive, and affective behaviors, and the task performances (psychomotor behaviors) of students.
2. The adequacy and appropriateness of the content of the newly developed course and instructional materials.
3. The educational process, its adequacy and appropriateness with a consideration of: administrative support, teacher effectiveness, and environmental conditions.

By investigating these, an indirect estimate of the adequacy of the cluster programs was determined.

To investigate the first area of research mentioned above, pre and posttests were administered to control and experimental groups. The following cognitive changes of behavior were studied:

(a) The student's knowledge of the human requirements specified for the respective cluster program the student had pursued.

(b) The student's technical knowledge and task performance required in the occupational cluster in which he participated.

(c) The student's achievement of knowledge related to the requirements, characteristics, and opportunities of occupational fields within the parameters of the cluster he was engaged in.

The affective changes were limited to selected vocational interests, vocational preferences, and aptitudes analyzed in terms of trends, shifts, and changes as empirically determined.

The second area of investigation was performed to evaluate and to assure control and the proper functioning of the programs throughout the year. Feedback information, gathered by the visiting research team, from schools operating cluster programs, provided descriptive data and a history of events recorded by the use of evaluative scales and anecdotal records. The various tasks that were structured into the cluster programs, as expected behaviors of performance, were used as an index to determine what has and has not been completed in one year and as a criteria for evaluating student performance.

The third area of investigation was concerned with the study of selected supportive dimensions, including the administrative behavior, material and moral support, physical facilities, and teacher effectiveness. These evaluations were presented in descriptive terms, whereas an appropriate attempt was also made to quantify certain categories of observed behaviors.

1. Estimating the effectiveness of the cluster programs on the basis of the impact on student cognitive and affective behaviors.

To investigate the degree and nature of behavioral changes of students who studied within the cluster concept program, control and experimental groups were established. The experimental group completed one academic year of training in a cluster program taught by specially trained teachers. For the same interval of time a comparable group, the control group, pursued singular goal-directed vocational courses. Both groups were tested on a battery of pretests and posttests measuring the variables considered central to determining the effect of the experiences gained in the cluster programs. The tests included newly developed achievement tests for each cluster, the Minnesota Vocational

Interest Inventory, the D.A.T. Mechanical Reasoning Test, and an instrument to evaluate the students' knowledge of occupational information.

Control variables were incorporated to assure continuous functioning of the programs and the identification of comparable students. Scheduled visitations conducted by the research team and instructional materials served to keep the programs and activities on the prescribed course. Verbal or lingual ability and intelligence scores were obtained from school records to establish a criteria for comparability of the subjects. In several schools these were not available; however, intelligence scores or scores from the Mechanical Reasoning Test served to determine the homogeneity of students. This study did not circumvent the limitations created by inadequate samples, the differences in the art of teaching, and the limitations of reductionism which does not consider homo-sapiens as a total organism. Each school operation was considered unique and each program was evaluated independently.

Full control of all the variables necessary for an ideal experiment was not achieved; therefore, this study was completed in the tradition of quasi-experimental design with full recognition of the factors which rendered the results equivocal.

Collection and treatment of data. Subjects from ten senior high schools in four Maryland counties have participated in this study. One school had two cluster programs, each taught by a cluster instructor; thus, eleven teachers and eleven separate cluster programs were included. Each cluster program was compared with a control group composed of students from a traditional vocational education course. Each school was considered and evaluated as a separate experiment.

Comparability or homogeneity of the students forming both groups was established on the basis of intelligence test scores; whereas in some schools, on the basis of lingual or verbal abilities scores, and in another, on the basis of scores from the D.A.T. Mechanical Reasoning Test. In all but two experiments the analysis of variance statistic was two groups on the basis of derived data. The .05 level of significance was considered minimal in all data analyzed. Prior to testing the differences, the F max ratio was used to determine homogeneity of variances.

The effectiveness of the treatment on the cognitive abilities, as measured by the newly developed cluster concept tests and the Mechanical Reasoning Test, was investigated. The investigation included the determination and analyses of:

1. Differences in abilities of students from each group on scores derived from tests at the beginning of the experiment.
2. Final differences between the experimental and control groups on the basis of pretest and posttest scores.
3. Growth or gains in cognitive abilities of all groups on the basis of the differences between the pretest and posttest.

Findings: construction cluster. Four schools implemented the construction cluster programs. The subjects of the programs had an intelligence quotient range from 87.93 to 99.27. Achievement test data indicated that three schools were successfully meeting the cognitive objectives of the cluster programs while one school was observed to have a very limited success.

In Schools A, C, and D the cluster groups achieved significantly higher scores over the control group on posttests of achievement. Also in the same schools the gains or growth in development from the time of the pretest to the posttest was significant. The control groups studying within a related traditional vocational course did not achieve significant gains.

Data derived from School H supported the finding that only a modest increase in student cognitive abilities was achieved. By analysis of the responses of students to the construction cluster test, it was evident that the students were not provided experiences in all the tasks prescribed for the program. The difference between the control group and the cluster group was statistically insignificant.

The investigation of the cluster programs and traditional programs on the achievement of those abilities measured by the Mechanical Reasoning Test yielded the finding that both programs had an insignificant effect on the students.

Recommendations. Since the data indicated that the objectives of a cognitive nature have been met with varying degrees of success, it was suggested that the teachers deliberately emphasize these objectives and that a balance be established between manipulative and theoretical studies. To achieve this balance more time and pedogogical effort should be alloted to the study of the underlying knowledges and problem solving skills associated with the construction trades of carpentry, masonry, plumbing, painting, and electricity.

Test analysis revealed that some teachers emphasized the human requirements of one or two occupations and gave only token consideration to the human requirements of other occupations. Truncation of the cluster program or incomplete consideration of the tasks must be avoided.

The full impact of the instructional process was not achieved. Nullifying effects impinging on the instruction were caused by problems of logistics, administrative support, the lack of equipment, and proper facilities. Many of these problems emerged due to the concurrency of evaluation and implementation during the first year of operation. Such problems, in a large measure, would not appear if the field operations were performed for two years or one cycle before conducting an evaluation of the effectiveness of the programs.

Findings: metal forming and fabrication cluster. Four distinct cluster groups and control groups were used for investigating the effectiveness of the programs. The subjects comprising the sample population had a range of intelligence quotients set by a low of 95.44 and a high of 104.20. Data derived from the total test score of the metal forming and fabrication cluster test provided evidence that all schools were achieving the cognitive objectives. Differences between pretest and posttest data indicated that students of the cluster group made significant gains; whereas the subjects of the control group did not. Statistical treatment applied to data derived from posttests of both groups provided evidence that the experimental group achieved significantly higher scores than the control group. The observed changes of behaviors were evidence that the cluster program was achieving the cognitive objectives.

Research data derived from the D.A.T. Mechanical Reasoning Test indicated that both types of vocational education programs had insignificant effect on the development of the abilities required to solve problems of applied science and technology.

Recommendations

Analysis of the achievement tests provided evidence that students had varying degrees of success in the knowledges of welding, machining, sheet metal and assembly work. While total test scores indicated that the objectives were being met, the variability of the scores from each sub-area suggests that teachers were emphasizing certain areas more than others. The reasons for this behavior were due to the many variables impinging upon the teaching process. These reasons are presented in the following pages.

Since the various abilities of the four teachers complement each other, seminars and small group meetings should be held to enable the teachers to exchange and share their special talents. Team teaching would greatly advance the cluster program; however, the proximity of the various schools made this impossible.

Findings: electro-mechanical installation and repair. Initially this program involved three schools. Due to many diverse problems of scheduling and other failures to meet the basic expectations for operating a cluster program, one field operation was discontinued. Consequently, two field operations completed one year of work implementing the new program.

Neither school achieved high enough scores on the achievement test to enable the recognition of significant differences between the control groups and experimental groups. The control groups were composed of a student body with relatively stronger backgrounds in the study of electricity than the cluster groups. The subjects of the control group also tended to be more capable on the performance of the Mechanical Reasoning Abilities Test.

The cluster programs encountered many difficulties in the procurement of proper facilities and equipment such as business machines, refrigeration units, and air conditioning equipment. These problems caused severe delays for implementing those areas of study which would enable the students of the cluster group to gain knowledge which distinguished the differences between the programs.

Recommendations

The pilot programs were found to be short of representing a model of the electro-mechanical cluster. It was found that more concentration of pedogogical effort is required in the subject fields of typewriter repair, business machines and air conditioning. The participating teacher must extend both the variety and the depth of the study of the occupational tasks and human requirements outlined in the cluster concept instructional materials. It will be necessary to provide the instructors with additional training to upgrade their competencies. This should be done in a series of short seminar sessions at the university with the use of consultants.

Affective Behaviors

The affective behaviors studied were limited to occupational preferences and interests measured by the Minnesota Vocational Interest Inventory and a supplementary questionnaire constructed by the research team. The purpose of this aspect of the study was to obtain an estimate of the impact the cluster concept program made on students by comparing data derived from control and experimental groups. The basic rationale of the cluster program is based on the premise that occupational interests should be broadened and that a student should remain flexible as to his commitment to an occupational choice. Accordingly, it was expected that students engaged in the traditional "one-goal directed" vocational program would manifest different behaviors than the cluster concept students.

Collection and treatment of data. The MVII was administered by the research team at the beginning of the academic year and at the end of it. The administration time varied extensively and it was necessary to allow several class periods to complete. The students were encouraged to persevere at the task since they generally were slow readers. The test answer sheets were scored commercially. Upon their return to the research center, they were analyzed and studied for dissimulation and other irregularities. A master profile chart was constructed which enabled data for each student to be recorded and readily observed. From the master charts summary tables were made which included quantified data in terms of frequencies and percentages. The tables are presented in the text of this report.

Findings

The data derived from the MVII were perplexing and generally unsatisfactory for clear analysis. Small differences between pre and posttests and control and experimental groups were observed. No clear patterns or directions of student preferences were found. A greater degree of fluctuation in the direction of or away from occupations the students actively studied was observed; whereas less fluctuation of choice for unfamiliar occupations was exhibited. Slightly more ambivalence or flexibility of choice was observed to take place within the cluster group than the traditional vocational education group.

Recommendations

The modest changes of behaviors of the subjects strongly suggest that more deliberate effort needs to be exerted in providing students with occupational information. Field trips to industrial plants, guest speakers from management and skilled workers, audio-visual devices, and special resource personnel should be used to further develop a realistic understanding of the students' knowledge of vocational requirements.

The research staff recommended that the MVII not be used in the phase IV of the cluster concept project. The following reasons were advanced for abandoning or limiting its use:

1. The relatively low reading ability of the subjects contributed dissipating the validity of the results.
2. Since all scales were not relevant to the investigation of the cluster program, some aspects of the inventory were discarded.
3. The inventory should be used for individual guidance purposes at the end of phase IV, during which job placement of the subjects will take place.

The supplementary questionnaire. A supplementary instrument was developed to obtain an estimate of the students' knowledge and attitude relevant to selected job factors such as human relations, status, security, advancement, remuneration, changes of job requirements and geographic displacement. By this means the research team sought to obtain evidence for determining if the objectives of occupational information are being implemented. The questionnaire was administered at the beginning and the end of the experiment.

Findings from the supplementary questionnaire. Within the various groups of subjects, it was found that between twenty-five and forty percent of the boys were dissatisfied with high school and would prefer to be productively employed or pursuing on-the-job training.

Of the students who realized the value of completing high school, an increase in the number of students preferring to study in a technical institute was observed.

The students' attitudes pertaining to geographic mobility remained relatively unchanged. On both the pre and post measures there were slight indications of preferences for the desire for jobs away from their present locations. An increased acceptance of the idea for the need to upgrade themselves,as the technology changes,was found. There was also an awareness that this was essential for promotion, increased wages, and an improvement in status.

On the basis of the differences from the pretest to the posttest measures, the number of students who expressed an appreciation for obtaining broad entry level skills as opposed to specific in-depth training increased.

More detailed analysis of the items of the questionnaire are provided in the text.

Recommendations. The objectives of the cluster program, which sought to promote an understanding of the concepts that occupational selection and career development is a life-long process, were only modestly achieved. Deliberate effort on the part of the teachers to discourage the mechanistic viewpoint of the one right,life-long job for each person, must be advanced. Examples of how prior experiences and potentialities of entry level tasks should be explored.

2. Evaluation of task performances of students and teachers.

The effectiveness of the three cluster concept programs were further investigated by indirect methods. Field observations were conducted during which evaluations and records of specific overt behaviors of students and teachers were made. The specific behaviors were referred to as job tasks or the expected performance tasks and set forth in objective behavioral terms proposed by Gagne.[2] The tasks were incorporated into the course materials, inventory charts, and evaluation charts. The teachers' progress in implementing the instructional materials and student progress were recorded by the use of these devices. Data were collected by scheduled and unscheduled visitations by the research team.

The progress and evaluation charts provided a record of those tasks completed, those tasks that have been completed and need further study, and those tasks which, for one reason or another, have not been considered at all. The task evaluation charts provided records of the task each subject completed, satisfactorily, unsatisfactorily or not experienced in the program.

Findings: metal forming and fabrication tasks. The general concluding statements reported below were derived from the specific data presented in Part III.

During the first year of conducting the pilot studies, the range of tasks completed was from fifty to sixty-seven percent. Data gathered tended to indicate that it was necessary to review from twenty-five to thirty-four percent of the tasks. This was mainly due to the lack of equipment, the complex nature of the tasks, or the lack of time. An approximate statement would be that fifty percent of the tasks included in the instructional materials were completed.

---

[2] Robert M. Gagne, The Conditions of Learning (New York: Holt Rinehart and Winston, Incorporated), p. 243.

Pending final assessment of the programs following the second year of research, it is anticipated that it will be necessary to develop more tasks. The specific type should be determined by the consideration of each program and in the manner specified in phase I. This should be done by the research staff, the teacher, and consultants from business and industry.

Findings: construction cluster tasks. The summary statements reported below were derived from the specific data presented in Part III.

At the completion of the first year of experimentation with the construction cluster in four different schools, it was evident that from thirty-four to sixty-seven percent of the tasks incorporated in the course of studies were completed. Of the tasks completed,from fifty to sixty-six percent of the tasks will be reviewed in the second year of research. Various causes were advanced in Part III for the inability to complete all specified tasks.

Findings: electro-mechanical installation and repair. The following general statements were derived from the specific findings presented in Part III.

The two programs implementing the electro-mechanical cluster completed approximately fifty percent of the tasks; of these, two thirds will of necessity be repeated in the second year.

In one program twenty-five percent of the tasks in air conditioning and refrigeration were taught; whereas in the other school ninety percent were completed. Forty percent of the tasks in business machine repair were completed in one school; whereas twenty percent were completed in the other. The differences of tasks completed reflected the inadequacies of tools, equipment, and materials. The need for repeating tasks was due to late arrival of equipment and lack of time. The lack of time was attributed to the setting up and the establishing of adequate laboratories during the year.

3. Evaluation of the instructional process.

The third area of investigation was concerned with the evaluation of selected supportive dimensions including the: (a) administration, (b) teacher, (c) physical facilities, and (d) community acceptance.

For a lack of a rigorous, quantitative methodology to evaluate the dynamic process such as the art of teaching, the methods resorted to were visitations, gathering data by observation, and the rational interpretation of data and events. Every attempt was made to gather information on the basis of objective and observed behaviors.

Visitations to the field operations were conducted by two groups at different intervals. One group was composed of an administrator from the State Department of Vocational Education, the County Supervisor of Vocational Education, the principal investigator, the research coordinator, and the high school principal. This was considered the supervisory team; whereas the research team was composed of four research assistants.

In addition to anecdotal records, the following devices were a means of obtaining further information.

1. Personal vita and records of cluster teachers.
2. Survey forms for an inventory of the tools, materials, and equipment for each cluster.

3. Drawings and sketches of physical facilities.
4. Visual medium such as drawings, plans, photographs, and written descriptions of practical work performed while implementing the course outlines.
5. Student progress charts.
6. Student evaluation charts.

Findings: construction cluster. The construction cluster was implemented in four counties. Administrative support from the state, county and local levels ranged from enthusiastic verbal support to active participation in overcoming the problems of procurement of materials and equipment. The problems of shortage of materials and equipment required to implement the program were not fully resolved and this condition resulted in serious limitations for completing the tasks specified in the instructional materials.

All teachers of the construction cluster had adequate practical experiences and academic background. Teachers with degrees in industrial education tended to conduct the program in a superior manner. Most teachers tended to emphasize those occupational tasks for which the laboratory was originally designed and equipped. Various degrees of teacher effectiveness were observed. One teacher conducted an outstanding program which met all the expectations and provided the students with all the tasks specified in the instructional materials.

The programs were conducted in laboratories which were too small for the diverse activities required in the cluster program and frequently, cluster activities were performed on the school grounds.

A need to remodel and install additional electrical power sources arose,thus causing some delay in implementing the course activities.

Varied activities of interaction with the community were observed. All teachers conducted field trips to construction sites and industrial manufacturers. A few resourceful teachers obtained free materials to augment their stock of materials and supplies used in construction industries. Local newspapers disseminated information describing the cluster concept programs. Approximately ninety percent of the cluster students within one outstanding operation were gainfully employed during the summer vacation.

Findings: metal forming and fabrication cluster. Four separate field operations were implementing this cluster. The programs were restricted in different ways and varying degrees due to the lack of equipment and materials. Severe shortages at the beginning of the program compelled the teachers to concentrate their pedagogical efforts toward less than the four occupations of the cluster. However, no field operation was distinguished as having a full complement of materials and equipment which the cluster programs required.

All teachers of this program had B.S. degrees and varying amounts of time in advanced graduate course work, military service, and industrial experience. This group of cluster teachers was evaluated to be most effective in meeting the expected goals of the new programs.

The use of laboratories which were designed for the study of a single occupation did not provide sufficient working area and in some situations, ample source of power.

Teacher interaction with the industrial firms resulted in the procurement of free materials, technical information and jobs for students during the summer vacation.

Findings: electro-mechanical installation and repair. This cluster program did not escape the damaging effects caused by inadequate supplies, materials, and equipment. The requisition-acquisition time lag strongly suggests that all programs should have been in operation several years before an evaluation was attempted.

Administrative support was noticeably lacking at one school where the teacher was assigned an unusually high teaching load. His teaching experiences were minimal and his needs for preparatory time were not met.

One field operation was dropped from the research due to failures of meeting the specifications of the cluster programs.

Both teachers were resourceful in obtaining some materials and equipment from local commercial establishments. They tended to place more emphasis in the study of air conditioning, refrigeration and typewriter repair with little or no consideration of the other facets of the cluster program. A neglect to utilize community resources for class field trips and other activities was evident.

Recommendations. The major purpose for conducting the evaluation of the program was to obtain information which when translated would enable plans for improvements, making changes and additions, determining preparatory measures for the second year of research, and establishing immediate, remedial, and long-range goals. The recommendations presented below were derived from a consideration of the findings presented under point 3.

A. Administration

1. Administrators, including the industrial education supervisors, should be requested to regularly engage in observing classroom procedures, reviewing task performances and inventories of

tools, materials, and equipment.

2. The results and problems of the first year research should be reviewed on a personal basis with the supervisors and local school administrators.

3. Several general meetings, including the assistant director of vocational education, the county supervisors, the cluster concept research staff and local school principals, should be held to review the progress and make plans for further abetting the cluster programs.

B. Teacher

1. Provide in-service training for the cluster concept teacher by using resource personnel from business, junior colleges, apprentice training centers and the military.

2. Conduct workshops to review the strengths and weaknesses of various programs for the purpose of seeking solutions to the problems which each teacher encountered.

3. The teachers should be encouraged to regularly review the progress and evaluation charts, and to develop learning experiences incorporating the prescribed cluster tasks.

C. Instruction

1. Teachers with the aid of the research team should draw up a list of tasks of each occupation which could not be completed due to equipment shortages.

2. Develop a list of meaningful projects that can be substituted for the utility building project and that will provide the same educational experiences.

3. Develop a comprehensive list of activities for the metal forming cluster which integrates tasks from all the occupations.

4. The research team, with the cooperation of the teacher, should compile a list of recommendations for changes in instructional plans for each cluster as published in Volumes II, III, and IV of the final report of phase IV.

D. Physical facilities

1. All possibilities for obtaining larger laboratory facilities, or the rearranging, or remodeling of the facilities used, should be explored.

2. Recommended floor plans and laboratory designs should be developed by the teachers and the research staff.

3. Designs for laboratories with due consideration of cluster activities, the arrangements of equipment, storage of tools, and materials, should be developed.

E. Community involvement

1. The teachers with the aid of the research staff should plan for obtaining local technical talent to reinforce the areas of study where weaknesses have been identified.

2. A resource list should be developed which included local industrial, commercial contracting and employment personnel who would be willing to make class presentations to vocational students on such topics as employment opportunities, employment outlook, preparation and expectations of various occupations.

3. Carry out a public relations program including activities such as exhibits during open house, brief talks and news

articles in the local newspapers.

4. Assist the cluster program teachers in making contacts with local industries, business establishments, and contracting firms which may furnish employment opportunities for the graduates of the cluster concept programs.

Final statement

The action research conducted made it evident that these special types of cluster concept programs have the potential of becoming vigorous alternate forms of vocational education. It was concluded that the programs did change student behaviors in the direction of the established objectives. Changes in behaviors, of cognitive abilities, of broadened interests, flexibility of occupational interests, and growth in performance tasks of skill were observed. The inadequacies, to fully resolve the problems encountered, should not in any measure be taken as reasons to discard the program, rather that which is known to be sound and affective should be retained and that which was found to be faulty provide a further challenge to the developmental process.

APPENDICES

APPENDIX A

GODDARD NEWS, Volume XIV, Number 2, August 21, 1967
National Aeronautics and Space Administration, Greenbelt, Maryland

INDUSTRIAL EDUCATORS SPEND 'FRUITFUL 2 WEEKS' AT GODDARD

Four high school teachers of industrial education report a "most fruitful 2 weeks" at Goddard, updating their technical know-how in four major areas of the Experimental Fabrication and Engineering Division (EF&ED): Welding, Machining, Assembly, and Sheet Metal Work.

The Maryland teachers were Harold Slimmer of the Frederick High School in Frederick County, Truman Doyle of the Boonesboro High School in Washington County, William Stewart of the Fairmont High School in Prince Georges County, and Porter Harrison of the Montgomery Blair High School in Montgomery County.

They were here from July 3-14 participating in a Pilot Cluster Concept Program for vocational educators, sponsored by the Industrial Education Department at the University of Maryland, under a grant from the U.S. Office of Education.

William Stewart, of the Fairmont High School, said: "While at Goddard I observed and was given the challenging opportunity to perform the latest skills required in modern metal fabricating processes. I'll share this information with my students this fall and help prepare them for the changing technology of our times."

Goddard coordinators of the program were: J. F. Taub, Head of the Aerospace Experimental Machine Branch; and Harry M. Bickford, Head of the Aerospace Metal Forming and Welding Branch.

APPENDIX B

A SUPPLEMENTARY QUESTIONNAIRE FOR THE CLUSTER CONCEPT PROGRAM

Name ______________________________

School ______________________________

Home Address ______________________________
____

Phone ____________________ Date ____________________

Directions: (Part I)

Appearing on the next page is a listing of several occupations. We are interested in securing information concerning your preferences of occupations.

Using a number system, express your preferences in order of what you like to do most; use (1) for 1st choice, (2) 2nd choice, (3) 3rd choice, (4) 4th choice, and (5) 5th choice.

Example:

_1_ X-Ray Technician

_2_ Nurse

_5_ Welder

___ Orderly

___ Nurse's Aide

_3_ Cook

___ Waiter

_4_ Plumber

Appendix B, continued

OCCUPATIONS

1. Rank your occupational choices.

_____ Carpenter

_____ Air Conditioning and Refrigeration Serviceman

_____ Assembler

_____ Electrician

_____ Mason

_____ Machinist

_____ Business Machine Serviceman

_____ Sheet Metal Worker

_____ Painter

_____ Plumber

_____ Home Appliance Serviceman

_____ Radio and Television Serviceman

_____ Welder

2. Indicate what you feel would be the best way to prepare for the occupations you have checked. Again use the rank order number system used in item 1.

_____ Complete High School

_____ On-the-Job Training

_____ Job Corps

_____ Night School

_____ Armed Forces

_____ Technical Institute

_____ Evening Work

_____ Apprenticeship

_____ Summer School

_____ Community College

_____ Others: Specify

Appendix B, continued

Directions: (Part II)

This section contains a list of statements which may or may not be characteristic of the occupations you prefer. Three possible answers represent your personal opinion and one answer is not necessarily better than some other answer. Place a check (✓) on the line under the answer that best expresses your opinion.

Example:

	Yes	No	Not Sure
The occupations I prefer call for working on the outside quite often.	___	✓	___

If No is the choice, a check should be placed under No.

* * * * * * * * *

	Yes	No	Not Sure
1. The occupations I prefer are available throughout the country.	___	___	___
2. The occupations I prefer will require me to make a change of residence at some time or another.	___	___	___
3. The occupation I prefer provides opportunities to advance through a series of higher job positions within one company.	___	___	___
4. The occupation I prefer requires a basic training which will enable me to step into several different kinds of jobs rather than one special job.	___	___	___
5. The occupation I prefer demands the performance of some basic duties upon initial employment. After a time more complex duties that require study and wider experiences will have to be performed.	___	___	___
6. The occupations I prefer will enable me to stay within the area I now live in.	___	___	___

Appendix B, continued

	Yes	No	Not Sure
7. The occupations I prefer pay sufficient salary at job entry and provide the possibility of higher wages after gaining experience.	____	____	____
8. The occupations I prefer do not pay too well but I am very interested in the operations that must be performed.	____	____	____
9. The occupations I prefer may require me to use tools and equipment in later years that are different from what we use now.	____	____	____
10. It would be better for me to get a broad basic knowledge about several trades rather than complete specialized training in one kind of job or trade.	____	____	____
11. Getting along and working with people in my selected occupation is more important than knowing every detail of the trade.	____	____	____
12. When I am employed in the occupation I have chosen people will think well of me for making a good selection.	____	____	____
13. The occupation I selected will be a stepping stone to some field or work in my future that does not clearly exist today.	____	____	____
14. I may start working in the occupation of my present choice but my interests may lead me to other fields.	____	____	____

Appendix B, continued

	Yes	No	Not Sure
15. My early occupational experiences will help me change to several different and better jobs as the years go by.	____	____	____
16. My best chances of success for the future is prepare for and stay with one special trade.	____	____	____
17. In some occupations the equipment and things you must know keep changing due to modern technology. I would prefer an occupation that does not change but remains the same year after year.	____	____	____

APPENDIX C

STATUS SURVEY OF TOOLS, MATERIALS, AND EQUIPMENT - CONSTRUCTION CLUSTER

____________ High School ____________ Instructor

____________ Date

		Tools	On Hand Before Start of Project	Obtained During School Year 1967-1968
1	set	Pipe dies 1/8-2"		
1		Pipe cutter		
4	12"	Steel rules 1/64-18"		
4		Hand seamers with depth gauge 1/4-1"		
4		Soldering coppers, 2 lb.		
3		Assorted yarning irons		
2		Picks, railroad		
2		Garden rakes		
2		Heavy duty thermometers		
4		Bricklayers jointers, assorted		
1		Stiff broom, 18" push		
2		Concrete edgers		
2		Joint rakers		
1		Serrated trowel		
10		Trowels-2 floats, 2 darbies 2 straight steel, 2 brick 1 drywall corner, 1 drywall joint		
2		Keyhole saws		
1		Drywall 6" elastic knife		
1		Drywall carrier-lifter		
2		Stapling hammers		
2		Hatchets		
1		Set of wood chisels		
4		Putty knives, elastic blade		
6		Hand scrapers, 3 x 2		
1	doz.	6' folding rule, wood		
1	doz.	8" steel tapes		
8	24"	Aluminum levels		
6	24"	Steel framing squares		
4		Shovels, 2 long handled round point, 2 square point		
2		Garden hoes		
5		8 point hand cross cut saws		
2		5 1/2 point hand rip saws		
5	10"	Hack saw frames		
2		Gooseneck wrecking bars, 24"		

Appendix C, continued

		Tools	On Hand Before Start of Project	Obtained During School Year 1967-1968
8		Hammers, 6-16 oz., 2-13 oz., 2 straight claw, 6 curved claw		
4		Ball peen hammers, 12 oz.		
8		Screwdrivers, assorted 1" - 8"		
1	set	Phillips head screw drivers		
1		Allen wrench set		
4		Adjustable wrenches, 4"-12" capacity		
1	set	Combination box-open end wrench, 3/8 - 1 1/4"		
4		Side cutting pliers, 8"		
2		Combination pliers, 8"		
1	set	Aviation snips		
1	set	Combination snips, 10"		
6	10"	Files - 2 bastard, 2 second cut, 2 smooth cut		
6		Wire brushes		
2	doz.	Flat utility varnish brushes - 1 doz 2", 1 doz. 3"		
1	doz.	Cold chisels, 2 each 1/4", 3/8" 1/2", 5/8", 3/4", 1"		
5		Nail sets, 1/32-5/32		
2		Rubber mallets, 2 1/2 x 6"		
1		Axe		
2		Sliding t-bevels		
1		Sledge hammer, 6 lb.		
4		Bricklayers hammers, 24		
2		Nail pullers, 18"		
2	sets	Wood bits, 1/4-1 by 16ths, 1-1 1/2 by 8ths		
2		Ratchet braces		
1	set	Auger bits		
1		Expansive bit		
1	set	HS twist drills, 1/16-1/2 by 64ths		
1	set	Masonry bits, 1/4-3/4"		
6		Bricklayers corner blocks		
2		1/4" Hand drills		
1	set	Star drills, 1/4-1"		
2	doz.	Paint applicator rollers		
3		Pipe wrenches, 8", 10", 12"		
2		Bench yoke vices, 1/8-2 1/2		
1		Smooth plane		
2		Jack planes		
1		Block plane		
2		Cable rippers		
1		50' fish tape		
2		Electricians knives		
1		Digging bar		
1		Conduit bender		
1		Wire gauge		
1		Pipe reamer		
1		Crow bar		
1		Earth tamper		

Appendix C, continued

		Tools	On Hand Before Start of Project	Obtained During School Year 1967-1968
2		Chipping hammers & brush		
1		Asbestos joint runner		
2	9"	Levels		
1		Copper tubing cutter		
1	4"	Soil pipe cutter		
1		Pot for melting lead		
6	8"	C-Clamps		

	Equipment	On Hand Before Start of Project	Obtained During School Year 1967-1968
1	Trap snake, 5 1/2"		
1	Gas welding outfit and accessories		
1	Portable jig saw		
3	Roof brackets		
1	Rubber tired wheelbarrow		
4	50" heavy duty lead cords		
3	Electric drills, 1/4, 3/8, 1/2		
1	8" portable electric saw		
1	3" x 24" dustless belt sander		
1	10" radial arm saw		
1	Sewer rod, 50" x 1/2"		
1	LP gas soldering kit		
1	Putty softener		
1	Impact tool		
1	14" drill press		
2	50' garden hose, 1/2"		
1	Heavy duty orbital sander		
1	Industrial vacuum cleaner		
3	6' step ladders		
1	20' extension ladder		
3	Paint roller pans		
1	Oilless diaphragm type compressor, adjustable spray gun, 1 qt. cap.		
1	Bench grinder		
1	Cement mixer, 1/4, 1/3 bag		
1	Mortar box		
2	10 qt. pails		
1	Salamander		
1	Pneumatic chisel		
4	Bench vises, 3 1/2" jaw		
1	Machine pipe cutter, reamer		

Appendix C, continued

	Equipment	On Hand Before Start of Project	Obtained During School Year 1967-1968
1	Gas soldering oven		
2	12 oz. oilers (pump)		
1	Used hot water heater		
1	Used Water pump		
1	Used toilet		
1	Used lavatory		
1	Used ceiling fan		
1	Portable tripod pipe vise		
1	Plumbers portable heating furnace		
1	24" Sheet metal brake		

	Materials	On Hand Before Start of Project	Obtained During School Year 1967-1968
400	Red common brick		
10	Fire brick		
100 ft.	Nylon Chalk line		
4	Pieces of chalk		
10	3" Octagonal boxes		
10	3" Octagonal box covers		
4	20 oz. Cans soldering paste		
5 lb.	Rosin core solder		
2	Rolls Electrician tape		
	1/8" x 3' threaded pipe		
50 ft.	Thin wall conduit		
1	Ground clamp		
20 ft.	Black iron pipe		
10	Romex switch boxes, 2" deep		
10	BX and conduit switch boxes, 2" deep		
10	BX box connectors		
6	Romex box connectors		
10	Conduit box connectors		
10	Conduit couplings		
6	1/2" Thin wall conduit elbow connectors		
	Assortment of small, medium and large wire nuts		
2	Pull type porcelain receptacles with 3 wire outlet		
10	Duplex receptacles with 3 prong outlet		
200'	Romex cable, 14 ga. with ground wire		
15'	6 gauge cable		
10	Singie pole toggle switches		
25'	2 gauge entrance cable		
1	Electric stove receptacle		

Appendix C, continued

	Materials	On Hand Before Start of Project	Obtained During School Year 1967-1968
1	60 amp. entrance panel		
1	Disconnect switch		
1	Entrance head for #2 cable		
1	(each) Door bell and buzzer		
100'	Low voltage bell wire		
2	(boxes) Insultated staples		
2	(boxes) Electricians staples		
2	Round brass push button bell switches		
1	Door bell transformer		
2	(boxes) Plug fuses, 15 amp & 30 amp		
20	Straps for 1/2" conduit		
2	(packages) Fiber bushing for BX		
200'	14 ga. single conductor wire, 100' white, 100' black		
2	Toggle switches with pilot light		
3	(doz.) Hack saw blades, 16, 24, 32 TPI		
2	(gals.) Gasoline		
1	(gal.) Cutting oil		
4	"Sacrete"		
4	(bags) Portland cement		
2	(bags) Lime		
1	(ton) Washed sand		
1	(ton) Crushed stone		
20	(lbs.) Each - 6, 10 penny common nails		
100 lb.	Each - 8, 16 penny common nails		
100'	1/2" reinforcing rod		
2	Bales straw		
1	20' x 20' Drop cloth		
1	20' x 20' Polethelene cover		
50	8 x 8 x 16 concrete blocks		
10	Safety helmets		
10	Dust masks		
25	Safety glasses		
25	(pair) Gloves		
200'	14 ga. Galvanized wire		
100	sq. ft. Reinforcing mesh		
1	(gal.) Clear waterproofing		
5	(gal.) Asphalt waterproofing		
1	(gal.) Clear cuprinol		
2	(doz.) Carpenters pencils		
300	Sheets flint paper, fine, medium, coarse		
3	(qts.) Past wood filler		
2	cans Plastic wood, walnut, mahogany		
1	(doz.) Rolls masking tape, 1/2"		
2	(gal.) Paint and varnish remover		
1	(gal.) Deft wood finish		
1	(gal.) Wood sealer		
1	(gal.) White shellac		
1	(gal.) Varnish		
4	(gal.) Assorted paints in quarts, interior and exterior enamels, flat and gloss, etc., latex oil base, etc.		

Appendix C, continued

	Materials	On Hand Before Start of Project	Obtained During School Year 1967-1968
1	(gal.) Primer		
4	(gal.) Paint thinner		
1	(qt.) Etching solution		
4	(lbs.) Glazing compound		
10	(lbs.) Finishing nails, 4,6,8 penny		
10	Metal hangers for supporting 2 x 8 floor joists, staples for stapling hammers, Impact cartridges for impact tool,		
	Assorted sizes and types of fasteners for connecting wood to masonry (toggles, shields, etc.)		
20	(lb.) Bag joint system		
20	(lb.) Bag topping cement		
30'	1/2" Rigid copper tubing,		
	Copper fittings for 1/2", 4 each elbows, tees, 2 each 45 elbow, coupling, cap, adapter, stop valve		
10'	4" Soil pipe, cast iron fittings for 4" soil pipe, 1 hub end closet bend with 1 1/2 tap, 2 elbows, 2 tee with 2" tap		
30'	Galvanized pipe		
	Galvanized fittings, 4 each elbows and tees, 2 each coupling, union, street elbow, plug cap, 45 elbow		
1	(can) Pipe joint compound		
10'	Clay drainage tile		
2	Mounting brackets for lavatory		
30	Semi-rigid plastic pipe, ABS, 1"		
2	(each) Plastic fitting, adapter, coupling, tee, elbow, bushing (1"),		
	1 can cement		
1	Toilet seat		
20'	Flexible plastic pipe, 1"		
2	(each) Plastic fittings, adapter, coupling, tee, elbow, clamps (1")		
15'	Foam plastic pipe covering for 1/2" pipe		
4	(packages) Wrap around pipe insulation		
2	Sheets 3' x 8' galvanized iron, 28 ga.		
20'	3/4 x 3/4 angle iron		
	Assortment of faucet washers		
4	2 x 6 x 12		
14	2 x 6 x 8		
14	2 x 6 x 10		
4	2 x 8 x 8'		
12	2 x 8 x 10'		
4	2 x 8 x 12'		

Appendix C, continued

Materials		On Hand Before Start of Project	Obtained During School Year 1967-1968
25	2 x 4 x 14 or		
50	2 x 4 x 8		
18	2 x 4 x 12		
13	1/2 x 4 x 8 plywood		
350	(bd. ft.) 1/6 or 1/8 T&G or shiplap		
5	3/4 x 2 x 8 insulating sheathing		
2	2 x 12 x 16'		
3	2 x 12 x 10'		
2	2 x 10 x 10'		
2	1 x 10 x 16 common		
2	1 x 8 x 10 common		
100	(bd. ft.) Porch flooring (fir)		
1	Adjustable jack post		
50	(sq. ft.) roll roofing (approx.)		
50	(sq. ft.) Half lap roll roofing with slate surface & adhesives (approx.)		
5	10' length of galvanized roofing		
18'	Ridge roll		
1	(roll) Building paper		
500	(sq. ft.) Aluminum foil		
75	(sq. ft.) Blanket insulation		
14	3/8 x 4 x 8 Sheetrock		
64	(sq. ft.) Rock lath		
2	(bundle) 1 x 3 Firring strip		
26'	Drip edge		
16'	Gutter with hangers, 8' downspout & fittings		
3	(tubes) Steel Wool--coarse		
5	(lbs.) Oakum		
20	(lbs.) Pig lead		
1	(gross) @ F.H. wood screws 1"-#8, 1 1/2"-#10 and R.H. wood screws 1"-#8		
5	(lbs.) Asbestos cement		
2	Sal Ammoniac blocks		
5	(lbs.) Assorted welding rod		
2	(qts.) 30w oil		
12	1/2 x 12 machine bolts		
6	(#6) Sash brushes		
2	Asphalt roof coating brush		
1/2	(pt.) Mahogany, maple, walnut		
2	Brush cleaner		
1	Glazier points		
5	(lbs.) Fire clay		
1	(gross) 1/2 x 6 sheet metal screw (pan head)		

Appendix C, continued

STATUS SURVEY OF TOOLS, MATERIALS, AND EQUIPMENT - METAL FORMING & FABRICATION CLUSTER

________________ High School ________________ Instructor

________________ Date

Tools			On Hand Before Start of Project	Obtained During School Year 1967-1968
12	12"	Steel scales		
6	24"	Steel scales		
12		Scribes		
6		Hack saw (hand) blades		
		Assorted files		
		Abrasive cloth		
1	doz.	Combination squares		
2		Protractor calipers		
4		Centerhead		
2		Hermaphrodite calipers		
3		Surface gauges		
6		Dividers		
1		Trammel points		
6		Prick punches		
6		Center punches		
1		Surface plate		
3		Countersink center drills (3 sizes)		
3		Outside calipers		
6	0-1"	Micrometer (outside)		
6	1-2"	Micrometer (outside)		
1	2-3"	Micrometer (outside)		
1	6"	Vernier caliper		
1	12"	Vernier caliper		
		Drills - taper shank		
		Drills - straight shank		
		Reamers - taper shank		
		Reamers - straight shank		
2		Boring bars		
2		Counterboring tools		
2		Parting tools		
1		Necking tools		
1	set	Fraction drills, 1/8-1"		
1	set	Number drills, to 3/4"		
1	set	Letter drills, to 3/4"		
		Number drill gauge		
		Letter drill gauge		
		Fraction drill gauge		

Appendix C, continued

Tools			On Hand Before Start of Project	Obtained During School Year 1967-1968
1	1/4"	Reamers		
1	1/2"	Reamers		
1	5/8"	Reamers		
1	3/4"	Reamers		
1	3-4"	Micrometer		
1	4-5"	Micrometer		
1	5-6"	Micrometer		
		Dial gauge (1/10000" graduation)		
		Lubricant cans or dispensers		
3		V-blocks		
1		Angle plate		
		Clamps		
1		Depth micrometer (1/10000")		
1		Plug gauge set		
1		Telescope gauge set		
		Spot facing tools		
2		Countersinks		
		Counterboring tools		
6		Center gauges		
1		Wheel dresser		
1		Vise		
1		Clamps		
1		Magnetic chuck		
		Parallel bars		
		Assorted shims		
1		Angleplate		
2		V-blocks		
		Assorted shims		
2		Assorted step blocks		
1		Sine bar 8"		
6		Plastic face hammers		
		Milling cutters		
1		Vernier height gauge		
		Inserted tooth cutters		
		Stagger tooth cutters		
		Spacing & bearing collars for Milling machine		
		Arbors & collets for millers		
		Assorted cutters for vertical milling machine		
		Slab		
		Helical tooth		
		Form relieved		
		Inserted tooth		
		Stagger tooth		
		Side		
		Spacing & bearing collars for vertical milling machine		

Appendix C, continued

Tool		On Hand Before Start of Project	Obtained During School Year 1967-1968
1 10'	Metal tape		
2	Sheet metal gauge		
3	Hand shears (straight)		
3	Aviation snips (R.H.)		
3	Aviation snips (L.H.)		
3	Combination snips		
1	Bulldog snips		
1	Double cutting snips		
2	Circle snips		
2	Hawk's bill snips		
4	Screw drivers		
2	Hand riveting tools		
3	Straight snips		
2	Compound shears		
2 sets	Fillet gauges		
4	Try-squares 8"		
4	Steel square 24"		
1/booth	Chipping hammers		
1/booth	Wire brushes		
1/p	Face shields		
1/p	Welding aprons		
6	Spark lighters		
1/booth	Welding tank wrenches		
2	Scales, balance		
	Measuring valve (adhesives)		
	Adhesive mixing vessels		
	Assorted clamps & jigs		
	Adhesive spray equipment		
	Assorted allen wrenches		
2 each	Phillips-head screwdrivers (2 sizes)		
3 each	Standard screwdrivers (3 sizes)		
2	Offset screwdrivers		
	Adjustable wrenches		
	Torque wrench		
	Socket wrench (T-handle)		
	Socket wrench (offset)		
	Socket wrench (ratchet		
	Open-end wrench		
	Box-end wrench		
3	Drift punch		
6	Hammers (assorted shapes)		
3	Cold chisels (11 sizes)		
2	Aligning punches		
1	Pipe vise		
	Assorted C-clamps		
3	Machinist's vise		
3	Swivel vises		
1	Pipe cutter		

Appendix C, continued

		Tools	On Hand Before Start of Project	Obtained During School Year 1967-1968
2		Diagonal cutting pliers		
1		Bolt cutters		
		Cold chisels (assorted)		
2		Side cutting pliers		
1		Tube cutter		
4		Combination pliers		
		Assorted shapes & sizes chisels		
		Assorted dies		
		Assorted wrenches for dies		
		Gasket punch		
		Hollow metal cutting punch		
2		Slideing T-bevel square		
2		Wire gauge		
		Assorted taps		
		Thread gauges		
1		Inside micrometer		
1	set	Gauge blocks		
2	sets	Inside calipers		
1		Folding tape		
1		Hook rule		
1		Thread micrometer		
1	set	Feeler gauge		
2		Ball peen hammers		
2		Straight peen hammers		
2		Cross peen hammers		
2		Wooden hammers		
2		Tack hammers		
1		Flaring tool		
		File cards		
		Oil stones		
		Tongs - long handled		

		Equipment	On Hand Before Start of Project	Obtained During School Year 1967-1968
2		Lathes		
2		3-jaw chucks		
2		4-jaw chucks		
2		collet set (assortment)		
2		face plates & assorted lathe dogs		
4		L.H. tool holders		
4		R.H. tool holders		
6	doz.	tool bits		
6		dead centers		
2		floating centers		

Appendix C, continued

	Equipment	On Hand Before Start of Project	Obtained During School Year 1967-1968
1	Power hack saw		
1	Power band saw		
1	Shaper		
	clamps		
	hold-downs		
	vises		
	tool holders		
	cutting tools		
1	Drill press		
1	Grinder (bench)		
	drill bit attachment		
	assorted grinding wheels		
1	Pedestal grinder		
1	Surface grinder		
	assorted wheels		
1	Horizontal milling machine		
1	Vertical milling machine		
1	Squaring shears		
1	Saber saw (metal use)		
1	Power squaring shears		
1	Ring & circle shears		
1	Bench lever shears		
1	Hand notcher & assorted blades		
1	Nibbler		
1	Portable power shears		
1	Slip roll forming machine		
1	Crimping machine		
1	Beading machine		
1	Brake		
1	Bar folder		
1	Pittsburg lock seam former		
1	Drive cap machine		
1	Spot welder		
4	Soldering coppers		
1	Power riveting tool		
	Dividing head & accessories for miller		
	Gas cutting torch & accessories		
	Ground wire & clamp		
	AC/DC welding machine		
4	Shielded welding booths		
	Regulators		
	Assorted welding tips		
	Gas cutting head		
	(MIG welding equipment)		
	consumable wire		
	Belt sander & abrasive belts		

Appendix C, continued

	Equipment	On Hand Before Start of Project	Obtained During School Year 1967-1968
1	Power riveting tool		
1	Electric impact wrench		
1	Reversible electric impact wrench		
2	Hand power drills		
	Anvil		
	Arbor press		

		Materials	On Hand Before Start of Project	Obtained During School Year 1967-1968
1	1 piece	Goggles		
1	12'	Cold roll steel (1 1/4" diam.)		
1	12'	Cold roll steel (3/4" diam.)		
1	12'	Cold roll steel (1/2" diam.)		
1	12'	Aluminum, 1" diam.		
1	12'	Aluminum 1/2" diam.		
6		Machine brushes		
1	gal.	Cutting oil		
1	gal.	Heavy oil (machine)		
1	gal.	Kerosene (for alum.)		
1	lb.	Can of grease		
		Lubricants		
		Oil (heavy)		
		Oil (cutting)		
		Kerosene (alum.)		
		Grease		
		White head		
1		Fraction to decimal chart		
		Cloth or waste materials		
6	pair	Gloves (handling sheet metal)		
		Metal adhesive compound		
		Solder		
		Flux		
		Tinning solution		
		Sheet metal screws		
		Bolts & nuts		
		Washers (tightening tools)		
		Rivets		
		1/4" Heavy plate		
		Filler rods		
		Electrodes		
		Brazing rods		
		Ferrous metal for welding exercises		
		Ferrous pipe stock		

Appendix C, continued

Materials	On Hand Before Start of Project	Obtained During School Year 1967-1968
Adhesives		
Chemical cleaner		
Abrasive cleaner		
Cleaning solvents		
Spray gun cleaners		
Allen screws		
Phillip-head screws		
Standard head screws		
Self-tapping screws		
Machinist's blue		
Copper sheets 8 to 25 am. gauge - selected sizes		
Steel rods, hexagon & square		
Cold roll, 1/4 to 3/4 in 12' lengths, selected sizes		
Round-cold rolled, dia. 1/8 to 1 1/4 selected sizes		
Sheet - #18, 20,22,24,26		
25 U.S. gauge-selected sizes		
Sheet, galvanized, no. 18, 20 22, 24, 26, 28 selected sizes		
Aluminium		

Appendix C, continued

STATUS SURVEY OF TOOLS, MATERIALS, AND EQUIPMENT - ELECTRO-MECHANICAL INSTALLATION & REPAIR CLUSTER

	Tools	On Hand Before Start of Project	Obtained During School Year 1967-1968
5	Screwdriver sets (standard tip-assorted sizes 1 1/2" - 8")		
3	Screwdriver sets (Phillips head-assorted sizes 3" - 8")		
1	Screwdriver ratchet		
1	Screwdriver offset		
5	Hex nut driver set		
3	Combination flare nut wrench set (3/8" - 3/4")		
5	Wrench sets - open end (1/4" - 1")		
5	Wrench sets - box end (5/16 - 1 1/8)		
1	Socket wrench set (1/4" - 3/8" - 1/2")		
6	Adjustable wrenches 6" - 8" 12" (2 each)		
2	Spanner wrenches		
1	Allen wrench set		
1	Special valve ratchet wrench (ref. work)		
10	Pliers combination		
3	Pliers - slip joint		
6	Pliers - needle nose		
2	Pliers - water pump		
2	Pliers - round nose		
6	Pliers - diagonal (3" - 6")		
3	Vice grips pliers		
3	Electricians pliers		
2	Pliers-gas & burner		
6	Pliers - wire strippers		
1	Hand riveter		
1	Torque limiting wrench (inch lbs.)		
1	Torque limiting wrench (foot lbs.)		
1	Pipe wrench (1" open)		
1	Set files (needle)		
3	Files - 8" - 12" single cut		
2	Files - round 8"		
2	Files - rat tail - 6"		
4	File card & brush		
2	Aviation snips		
4	Cold chisel sets (1/4" - 5/8")		
4	Punch & chisel sets (center & pin punch, cold chisel)		
3	Hammer, ball peen (2 large & 1 small		
1	Hammer, claw		
2	Hammer - soft face		

Appendix C, continued

TYPEWRITER REPAIR

	Tools	On Hand Before Start of Project	Obtained During School Year 1967-1968
5	#4 Wiring pliers with duck bill jaws		
5	#14 Parallel flat nose pliers		
5	#17 Diagonal cutting pliers		
5	#19 Long needle nose pliers with cutting jaws		
5	#42 Link bender		
5	#104-7C curved tweezers		
5	#90 Combination spring hook		
5	#77 Brass hammer		
5	#350 flat, double-end spanner wrench set		
5	#AVS - 175 oiler		
5	#81-6 screwdriver, 6" blades, 3/16 bit		
5	#46 Smitty Jr. Allen wrench set		
5	#81-8 screwdriver 8" blade, 7/32 bit		
5	#91 Spring hook set		
5	#81-4 "Yankee" screwdriver (heavy)		
5	4" blade, 3/16" bit		
5	#83-4 screwdriver (light) 4" blade 9/64" bit		
5	#83-6 screwdriver 6" blade 3/64 bit		
5	#83-8 screwdriver 8" blade, 9/64 bit		
3	#8-1 large cleaning brush		
3	#8-16 scrubbing brush		
12	Transparent plastic boxes (parts storage)		
3	Pen oiler #121		
3	Atomizer		
3	Adding machine grease gun		
3	#74 needle file kit		
5	#940 punch kit		
3	#550 tattleite tester		
1	#109 set of drills		
3	#210 ack-up & trip gauge		
5	#104-7 tweezers		
2	#86 offset screwdriver		
1 each	#TR-4 hold-e-zee screwdriver		
	#TR-6 hold-e-zee screwdriver		
	#TR-8 hold-e-zee screwdriver		

Appendix C, continued

	Tool	On Hand Before Start of Project	Obtained During School Year 1967-1968
3	Hacksaws 10"		
2	Levels		
2	Steel rules (8')		
1	Compass saw		
1	Pyrometer		
1	Thickness gauge (.0015" = .025")		
1	Jaw puller		
1	Set T.V. alignment tools		
1	Socket punch set		
1	Jumper cable for TV		
1 set	Rigid spring-type tube bender (set of 8 - 1/4" - 7/8")		
1	Soldering gun		
1	Soldering iron (small with interchangable tips)		
1	Pring type tubing bender (set of 6 - 1/4 - 5/8)		
3	Tube cutter 1/8" - 1" diam. with rollers		
3	Hand reamers 1/8" - 1/2" diam.		
3	Flaring tools 3/16 - 5/8 o.d.		
1	Sawing fixture for cutting tubing		
5	Stem type refrigeration thermometer		
1	Dial type thermometer with a remote sensitive bulb		
3	Reamers (hand) 1/8 - 1/2" diam.		
3	Spiral flute burring reamers 1/8 - 1 1/4"		
2	Swage set (set of 5 5/16 - 7/8" o.d.)		
1	Pipe threader sets (1/4 - 1 1/2")		
1	Pipe cutter		
1	Spiral ratchet pipe reamer (1/8 to 2" capacity		
3	Soldering guns		
1 set	External tubing brushes 3/8" - 1"		
3	Internal tubing brushes		
6	12" steel rules		
4	Mallets (1 1/2 - 2 lb.) (wood or rawhide)		
1	Fitting resurfacer		

Appendix C, continued

Typewriter Repairs

Materials			On Hand Before Start of Project	Obtained During School Year 1967-1968
5	gal.	Typewriter oil		
5	gal.	Varsol		
1	gal.	Dentured alcohol		
1	gal.	Ammonia (household)		
5	gal.	Lix cleaner		
12		Typewriter oil in spray cans (16 oz. can)		
12		Droil (solvent for loosening frozen parts - 12 oz. can)		
		Dry graphite		
12		Cleaner-lubricant spray cans (6 oz. cans)		
1	lb.	Non-fluid oil (adding machine lub.)		

Appendix C, continued

	Materials	On Hand Before Start of Project	Obtained During School Year 1967-1968
12	Penetrating oil (spray cans)		
1 lb.	Nichrome resistance wire		
Asst.	Bakelite wire (nuts) connectors		
"	Key & rivets		
"	Cotter & shear pins		
"	Retaining rings		
"	Bolts & nuts		
"	Cap screws		
"	Set screws		
"	Sheet metal & self tapping screws		
"	Washers - flat & lock		

Appendix C, continued

Equipment			On Hand Before Start of Project	Obtained During School Year 1967-1968
3		Volt-ohm milimeter meters		
5		Continuity testers		
3		Amp-probes		
1		Amp-meter		
1		Low-range ohmeter		
1		Sling psychrometer		
1		Anemometer		
1		Manometer (mercury)		
1		Vacuum tube voltmeter		
1		Tube tester		
1		Signal generator		
1		Oscilloscope		
1		Capacitor tester		
1		Capacitor decade		
1		Resistance decade		
1		Audio generator		
1		Simpson thermo-meter with extra thermocouple leads		
4		Test cord sets		
1		Gas welding outfit & accessories		
3	pair	Asbestos gloves		
1		Heat jet soldering fit		
3		Welding goggles		
1		Halide leak detector		
3		36" flexible charging hoses		
1		Charging system		
1		Wet wick vacuum indicator		
1		Vacuum pump		
1		Electronic leak detector		
2	set	Gauge manifolds		
		Assorted pressure gauges		

Typewriter   Appendix C, continued

	Equipment	On Hand Before Start of Project	Obtained During School Year 1967-1968
5	KM brake turntables no. 102		
1	Steam cleaning system		
1	Air compressor		
1	Clean-o-matic tank (lg. set tub with two lg. galvanized tubs may be substituted)		
1	Oven or heat lamp		
1	Paint spray booth with exhaust system		
5	Mechanic's lamp		
6	Typewriters		
6	Tape Recorders		

APPENDIX D

ACHIEVEMENT TEST

CONSTRUCTION CLUSTER

LEVEL 1

Do not open this booklet until you are told to do so. On your SEPARATE ANSWER SHEET print your name, address, and other requested information in the proper spaces then wait for further instructions.

DO NOT MAKE ANY MARKS IN THIS BOOKLET

Cluster Concept Program
Industrial Education
1967-1968

Appendix D, continued

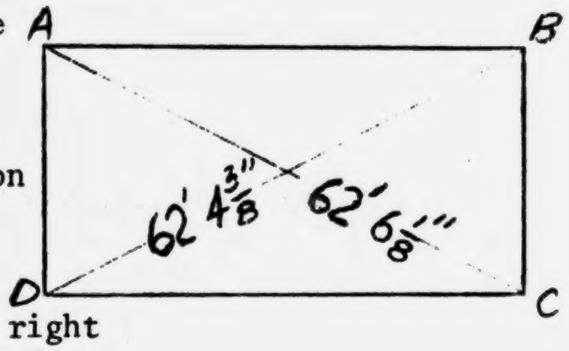
Directions for multiple-choice items requiring the BEST answer.

Each of the questions or incomplete statements listed below is followed by several possible answers. Choose the answer that best answers the question or completes the statement. Place the identifying letter of that answer (A,B,C,D, OR E) in the numbered blank space on the answer sheet that corresponds with the question on the test sheet. MARK ALL ANSWERS WITH A SOFT PENCIL - FILL IN THE SPACE COMPLETELY.

1. The best way of nailing down the sole plate of an exterior partition for a home is to nail it so the nails pass into the

    a) rough floor
    b) floor joists
    c) header
    d) sill
    e) B and C

2. In squaring up a foundation the distance AC and DB are measured and found to be 62' 6 1/8" and 62' 4 3/8" respectively. The distances AB and DC, and BC and AD are correct. To square up the foundation



    a) points D and B should be moved an equal distance to the left
    b) point B should be moved to the right
    c) point B should be moved up towards the top of the page
    d) points D and C should be moved an equal distance to the right
    e) none of these will correct the situation

3. The easiest means for one man to cut 4 x 8 plywood sheets to size for rough floor, sheathing and roof deck on a house is by using

    a) a radial saw
    b) a table saw
    c) a band saw
    d) a portable electric jig saw
    e) a portable electric circular saw

4. A gable stud

    a) runs from the double plate to the rafter
    b) is part of the roof overhang
    c) has a bevel cut on each end
    d) is a horizontal member placed above and below the louver
    e) is none of these

5. Building paper is used between finish siding and sheathing to prevent

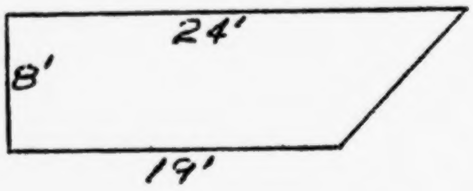
   a) passage of moisture
   b) passage of air
   c) passage of dust
   d) A and B and C
   e) A and B

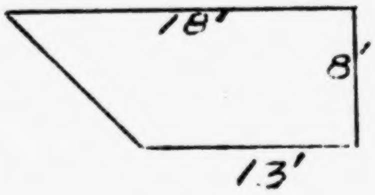
6. When possible the metal drip edge should be nailed so the nails pass into the

   a) fascia
   b) roof boards
   c) roof rafters
   d) the cornice
   e) the header

7. How many rolls of building paper are required to cover the two areas at the right? Each roll covers half a square.

   a) 3 rolls
   b) 7 rolls
   c) 5 rolls
   d) 6 rolls
   e) 9 rolls





8. The most practical and sensible way to clean a 12" tar brush would be to use
   a) gasoline
   b) turpentine
   c) kerosene
   d) alcohol
   e) detergent

9. A lag shield

   a) is put in place with an impact tool
   b) requires a hole the same size as the lag screw it is used with
   c) holds in the wall because of expansion pressure
   d) is screwed into the hole which is drilled for it
   e) cannot be removed once it is put into place

10. Batt or blanket insulation is most easily installed with a

   a) hammer and large head nails
   b) stapling hammer
   c) mastic cement
   d) stapling gun
   e) lath strip and wire nails

11. A drywall installation

    a) can be made quicker than a plaster installation
    b) may be made in two layers
    c) uses either 3/8" or 1/2" thickness board
    d) can be made with nails or cement or both
    e) all of these

12. The normal procedure in preparing dry wall joints for prime paint is to apply joint cement or compound in

    a) 2 coats
    b) 3 coats
    c) 1 or 2 coats
    d) 4 coats

13. If the following lengths of material are needed: 2-16", 1-2'3", 3-2'9", they could be cut with the least waste from standard stock lengths by using

    a) 1-12'
    b) 1-14'
    c) 2-8'
    d) 1-10' and 1-6'
    e) 1-16'

14. The standard spacing of framing members is

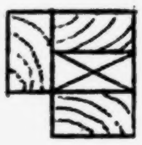
    a) 12"
    b) 14"
    c) 16"
    d) 18"
    e) 20"

15. Cross bridging should

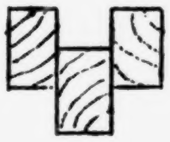
    a) be installed before the rough floor is laid
    b) not be nailed on the bottom until after the finish floor is laid
    c) stiffen the floor
    d) A and C
    e) A and B and C

16. Which of the following sectional views represent corner posts used in rough framing for house construction? All material represented is 2 x 4 stock.

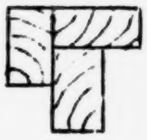
X



Y



Z



    a) X
    b) Y
    c) Z
    d) X and Y
    e) X and Y and Z

17. The most accurate device for locating all the stud positions along a house sidewall is a

    a) carpenter's square
    b) six foot folding rule
    c) 50' steel tape
    d) yard stick
    e) six foot steel tape

18. Four inch cast iron pipe is manufactured in lengths of

    a) three feet
    b) four feet
    c) five feet
    d) six feet
    e) eight feet

19. The enlarged end of a soil pipe is called a

    a) barrel
    b) hub
    c) spigot
    d) funnel
    e) none of these

20. In pouring lead into a cast iron pipe joint, all moisture must first be wiped off to prevent

    a) early rusting
    b) an explosion
    c) deterioration of the oakum
    d) the lead running through the joint
    e) too rapid cooling of the lead

21. Joint compound is applied to threaded pipe joints to

    a) prevent rust
    b) lubricate the threads
    c) prevent leaks
    d) A and B
    e) A and B and C

22. Given a grade of 1/4" per eight feet, the total grade for a drainage trench that is 100' long would be

    a) 5 1/8"
    b) 4 3/8"
    c) 2 7/8"
    d) 3 1/8"
    e) none of these

23. When placing a new washer in a leaky faucet, the first step after shutting off the water supply is to

    a) remove the faucet handle
    b) loosen the packing nut
    c) turn the faucet handle to "on" position
    d) drain the plumbing system at its lowest point
    e) select the correct size replacement washer

24. Reaming galvanized pipe during the thread cutting operation tends to

    a) restore the pipe to its original diameter
    b) make the thread die easier to start on the end of the pipe
    c) clean the end of the pipe so it is not as easy for foreign objects to lodge there
    d) A and B and C
    e) A and C

25. Before the prime coat of paint is applied, new woodwork around an entrance way to a house should

    a) be sanded
    b) have knots shellacked
    c) have the nails set
    d) A and C
    e) A and B and C

26. As a part of the process of rough wiring, a knock-out plug should be removed from an outlet box

    a) just prior to mounting the box
    b) just after mounting the box
    c) just prior to placing the cable in the box
    d) A or B
    e) B or C

27. Entrance cable should be cut with

    a) wire cutters
    b) hack saw
    c) aviation snips
    d) straight snips
    e) C or D

28. The purpose of grounding portable electric tools is to prevent injury if

    a) the operator is in contact with the ground
    b) a conductor inside the tool touches the housing of the tool
    c) the extension cord is not heavy enough for the load
    d) a fuse too small for the tool is used
    e) C or D

29. The National Electrical Code will not permit wire for regular circuits in a home to be smaller than

    a) 10 gauge
    b) 12 gauge
    c) 14 gauge
    d) 16 gauge
    e) 18 gauge

30. Solder used for electrical purposes should be

    a) rosin core
    b) acid core
    c) solid wire
    d) A or C
    e) A or B

31. The bottom and top of formwork is held securely in place by

    a) rods and spreaders
    b) bolts and cleats
    c) stakes and bracing
    d) twisted wire
    e) A and D

32. A concrete mix for ordinary foundation conditions is

    a) 2-3-4
    b) 1-2-4
    c) 1-2-2
    d) 1-3-6
    e) 1-3-1

33. In preparing material for mixing concrete on the job, the material which should be nearest the mixer operator when he is in position to feed the machine is

    a) sand and stone
    b) water
    c) cement
    d) A and C
    e) each of these has equal importance in being closest to the operator

34. The ingredient whose proportion in the mix is most important to the quality of the concrete is

    a) water
    b) cement
    c) sand
    d) stone
    e) lime

35. A cubic foot of concrete is heavier than a cubic foot of

   a) water
   b) sand
   c) stone
   d) cement
   e) any of these

36. Freshly poured concrete may be covered to prevent damage from the

   a) sun
   b) wind
   c) rain
   d) cold
   e) all of these

37. Wood scaffolding gets its stability from

   a) bracing
   b) the building it serves
   c) the grade of lumber used
   d) A and B and C
   e) A and B

38. Tuck pointing would be done by a

   a) painter
   b) glazier
   c) mason
   d) carpenter
   e) none of these

39. The amount of waterproof coating, which covers 75 sq. ft. per quart, that is needed to treat a concrete slab 19' x 27' is

   a) 1 gal. and 1 qt.
   b) 6 qts.
   c) 4 qts.
   d) 7 qts.
   e) none of these

40. Asphalt waterproofing is most effective on a concrete block wall when it is applied to

   a) the same side of the wall from which the moisture approaches
   b) the opposite side of the wall from which the moisture approaches
   c) a parged surface
   d) A and C
   e) B and C

41. Vibrating the concrete after it is poured in a form

    a) eliminates air pockets
    b) gives a better bond on reinforcing rod
    c) produces a stronger product
    d) A and C
    e) all of these

42. A screed is used for

    a) bracing a form
    b) measuring ingredients for mixing concrete
    c) placing a final finish on a concrete slab
    d) leveling freshly poured concrete
    e) holding reinforcing rod in place in a form

43. For a guide in laying concrete block between corners in stretcher courses the mason needs

    a) a line
    b) a square
    c) a ruler
    d) A and B
    e) A and B and C

44. The cement-sand proportion for brickwork mortar is

    a) 2-4
    b) 1-4
    c) 1-3
    d) 3-3
    e) none of these

45. The least expensive way to obtain additional training in the construction trades following graduation from high school would be through

    a) on-the-job training with a non-union contractor
    b) a correspondence course
    c) an apprenticeship program sponsored by a union
    d) attendance at a junior college or community college
    e) B or C

46. Wiring used in interior residential use is usually

    a) non-metallic sheathed cable
    b) armored cable
    c) enclosed in thin-wall conduit
    d) made up of three conductors
    e) none of these

47. The switches required for wiring a light with two point control are known as

    a) single pole switches
    b) double pole switches
    c) two-way switches
    d) three-way switches
    e) toggle switches

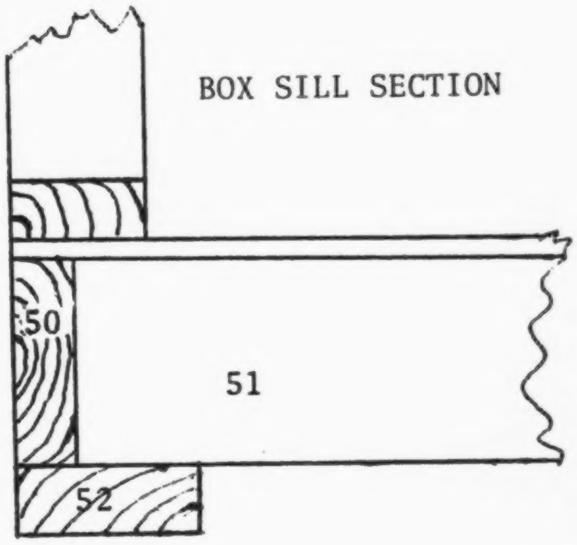
48. A brick wall may be pointed up to improve its

    a) appearance
    b) weather resistance
    c) strength
    d) A and B
    e) A,B and C

49. In order to make the old putty easy to remove when replacing a broken window pane, a putty softener makes use of

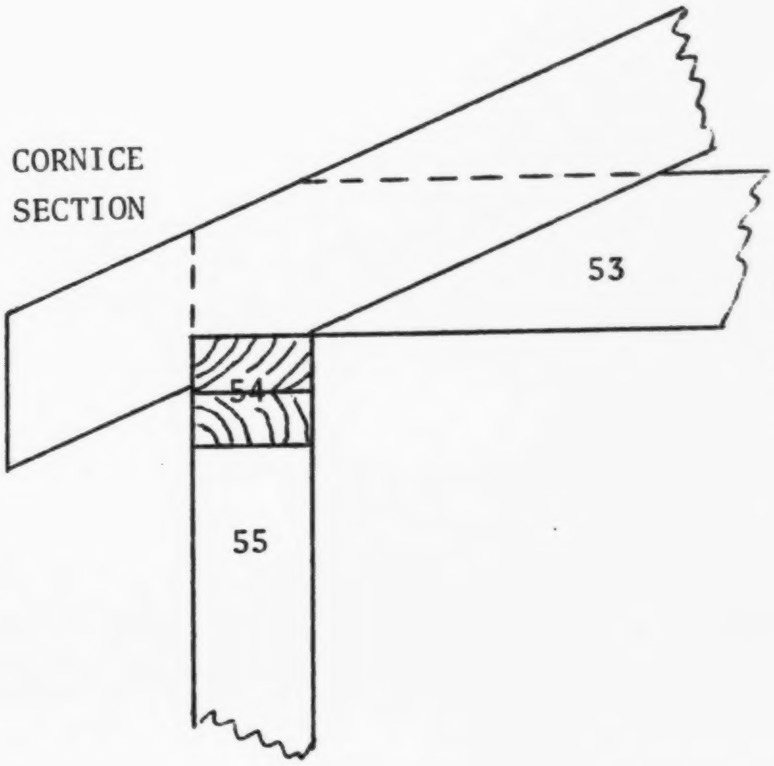
    a) heat
    b) solvent
    c) pressure
    d) impact
    e) B and C

You are to identify the numbered parts of the sectional views which are illustrated below. Select the proper name for each numbered part from the list of parts on the right of each sectional view. Mark the identifying letter opposite the number of the part on the answer sheet.



BOX SILL SECTION

a) sole plate
b) sill
c) floor joist
d) girder
e) header



CORNICE SECTION

a) fascia
b) stud
c) ceiling joist
d) rafter
e) plate

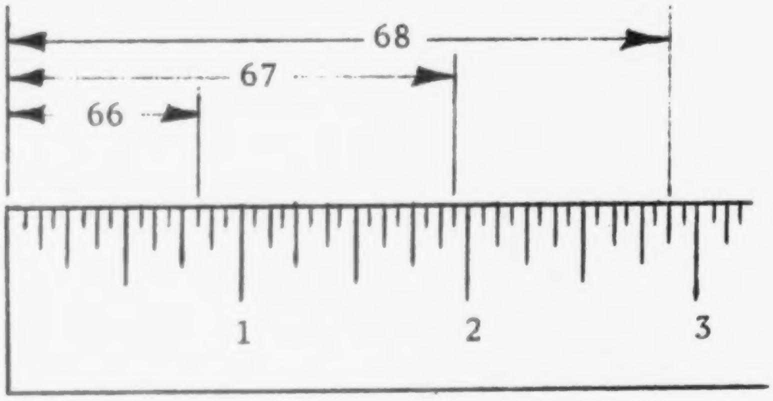
You are to identify the best thinner for each of the numbered finishes or finishing materials which are listed below. Select the proper thinner for each numbered finish or finishing material from the list of solvents on the right. Mark the identifying letter opposite the number of the finish or finishing material on the answer sheet. A thinner may be used for more than one finish.

56. latex base paint
57. enamel
58. deft
59. spar varnish
60. epoxy enamel
61. oil stain
62. paste wood filler
63. aluminum paint
64. rust inhibitive primer
65. shellac

Solvents

a) turpentine
b) lacquer thinner
c) water
d) alcohol
e) kerosene

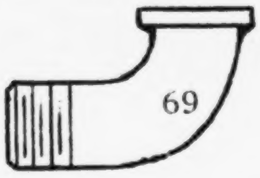
You are to identify the numbered lengths on the ruler which are illustrated below. Select the proper length for each numbered distance from the list of lengths on the right. Mark the identifying letter opposite the number of the length on the answer sheet.

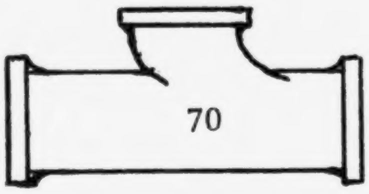


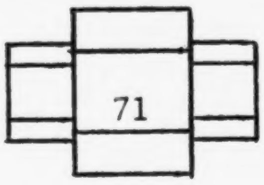
a) 3/4"
b) 1 15/16"
c) 13/16"
d) 2 5/16"
e) 2 7/8"

You are to identify the numbered illustrations which are listed below. Select the proper name for each numbered illustration from the list of names on the right of each group of illustrations. Mark the identifying letter opposite the number of the illustration on the answer sheet.

PLUMBING FITTINGS

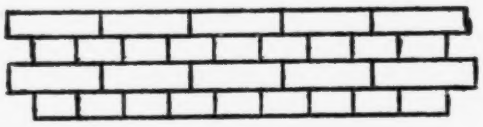

69

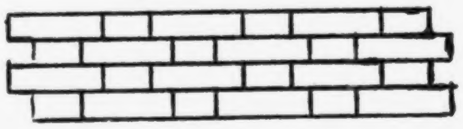

70

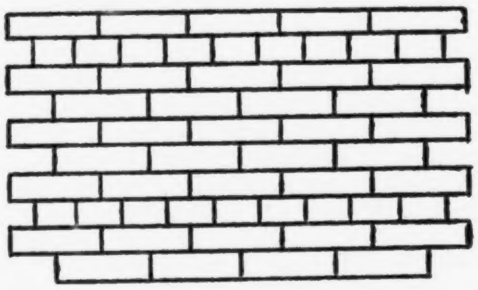

71

a) elbow
b) union
c) coupling
d) street elbow
e) sanitary tee

BRICK BONDS

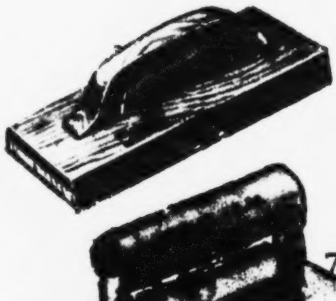

72

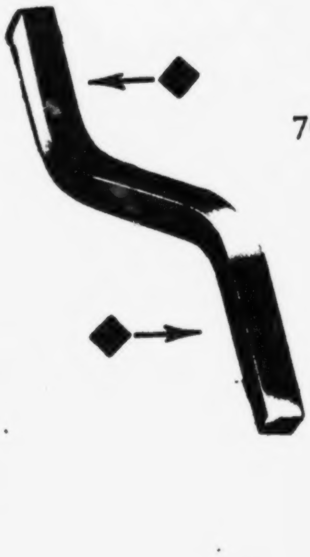

73

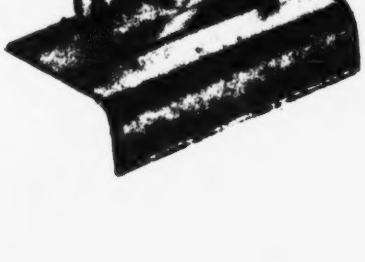

74

a) common
b) running
c) Flemish
d) English
e) basket weave

MASONRY TOOLS

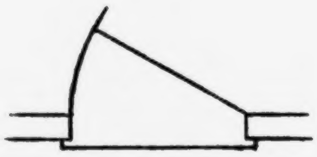

75

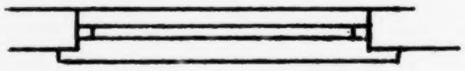

76

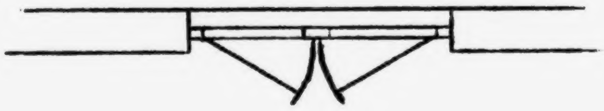

77

a) float
b) smoothing trowel
c) jointer
d) edger
e) hawk

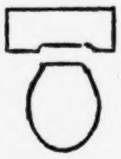
You are to identify the numbered symbols that are illustrated on the next three exercises which would be found on floor plans for a house. Select the proper name for each numbered symbol from the list of names on the right of each group of symbols. Mark the identifying letter opposite the number of the symbol on the answer sheet.

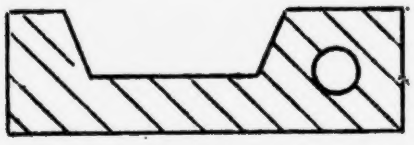

78

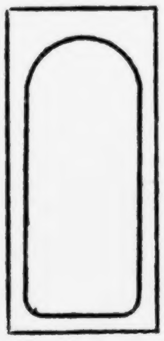

79


80

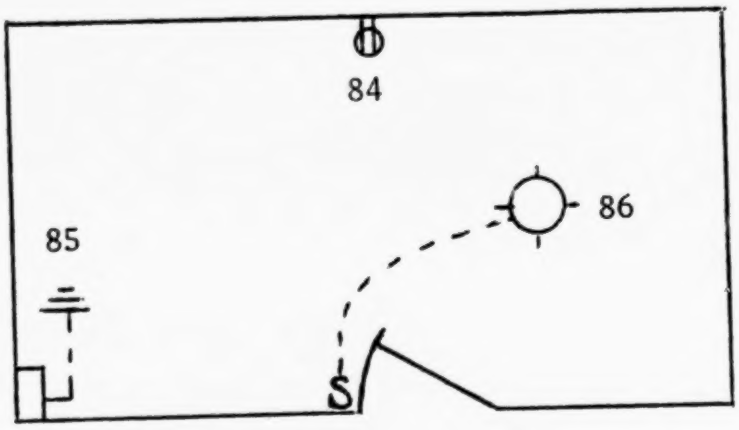
a) double-hung window
b) casement window
c) French door
d) interior door
e) exterior door


81


82


83

a) fireplace
b) archway
c) water closet
d) tub
e) lavatory



a) ground

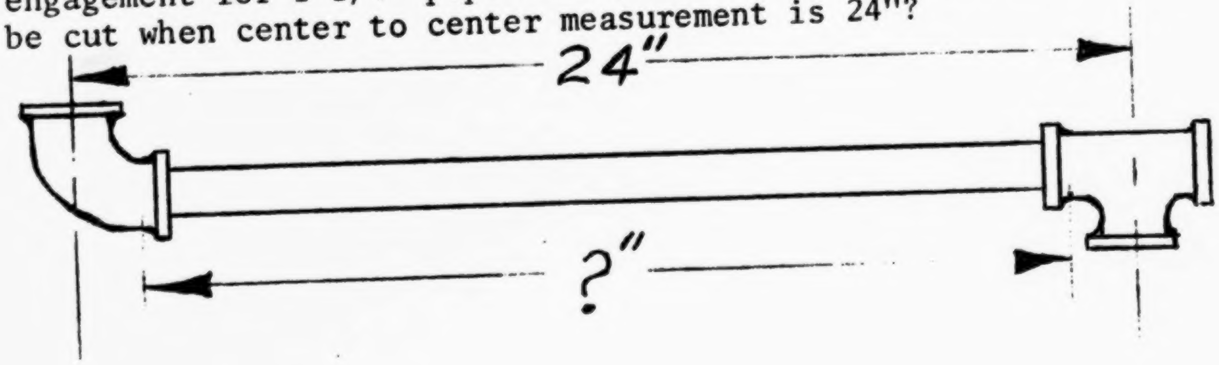
b) receptacle

c) ceiling fixture

d) range receptacle

e) conductor

87. Given center to end dimension for a 1 1/4" T as 1 3/4" and center to end dimension for a 1 1/4" 90° Elbow as 1 3/4" and normal thread engagement for 1 1/4" pipe as 11/16". How long must a piece of pipe be cut when center to center measurement is 24"?



A = 22 1/2

B = 23 5/8

C = 25

D = 21 3/16

E = 22 5/16

APPENDIX E

ACHIEVEMENT TEST

METAL FORMING AND FABRICATION CLUSTER

LEVEL 1

Do not open this booklet until you are told to do so. On your SEPARATE ANSWER SHEET print your name, address, and other requested information in the proper spaces then wait for further instructions.

DO NOT MAKE ANY MARKS IN THIS BOOKLET

Cluster Concept Program

Industrial Education

1967-1968

Each of the questions or incomplete statements listed below is followed by several possible answers. Choose the answer that best answers the question or completes the statement. Fill in the correct space on your separate answer sheet (A,B,C OR D). Make certain the number of the question corresponds with the number you are filling in on your answer sheet. MARK ALL ANSWERS WITH A SOFT PENCIL - FILL IN THE SPACE COMPLETELY.

MACHINING

1. An engine lathe with a four-step cone pulley and back gears has

   a) four spindle speeds
   b) as high as 24 spindle speeds
   c) eight spindle speeds

2. More torque and slower speed are obtained on the lathe by using

   a) reversing gears
   b) back gears
   c) apron gears
   d) headstock gears

3. An accurate way to find out how much stock must be removed in finish turning is to use

   a) a caliper
   b) dividers
   c) micrometer
   d) a surface height gauge

4. To adjust for different thickness of work pieces on the shaper

   a) swivel the vise
   b) adjust the length of the stroke
   c) adjust the table up or down
   d) use a different tool holder

5. The most common method of holding the work in a milling machine is with

   a) a chuck
   b) a swivel vise
   c) a dividing head
   d) strap clamps

6. What is meant by structure of a grinding wheel

   a) kind of abrasive
   b) size of abrasive particles
   c) arrangement of abrasive particles
   d) amount of bond

7. Which of the following methods is not commonly used for holding work on a milling machine

   a) clamps
   b) vises
   c) magnetic chuck
   d) dividing head

8. What instrument is best suited for testing and setting the vise jaws in relation to the milling machine spindle

   a) combination square
   b) solid square
   c) parallels
   d) dial indicator

9. Which of the following are not important factors affecting the efficient operation of the shaper

   a) setting the length of the stroke
   b) size of the table
   c) setting the position of the stroke
   d) clamping of the work

10. In the metal working shop a rule is used for

    a) precision measurement
    b) angular measurement
    c) semi-precision measurement
    d) rapid calculations

11. Which of these is not a principal method of shaping metal

    a) drilling
    b) grinding
    c) milling
    d) sawing

12. The successful action of a cutting tool depends primarily upon

    a) speed
    b) feed
    c) depth of cut
    d) all of these

13. To measure accurately any piece of work, the micrometer should first be opened larger than the object to be measured, then screwed down on the object until the end of the _____ and _____ are in contact with the object.

    a) barrel and thimble
    b) spindle and anvil
    c) frame and spindle
    d) thimble and anvil

14. The sum of .375 and .4375 is

    a) .5000
    b) .625
    c) .8125
    d) .7925

15. The sum of .250 and .21875 is

    a) .46875
    b) .48675
    c) .3175
    d) .64785

16. The difference between .3125 and .250 is

    a) .625
    b) .5625
    c) .0625
    d) .00625

17. The difference between .4375 and .1875 is

    a) .6150
    b) .025
    c) .250
    d) .052

SHEET METAL

18. Solder is made of

    a) lead and zinc
    b) tin and zinc
    c) babbit and lead
    d) lead and tin

19. Copper is distinguished by a color of

    a) reddish brown
    b) blackish green
    c) yellow gold
    d) silver (dull)

20. When drilling holes in sheet metal the metal is best secured by

    a) a "C" clamp
    b) a vise
    c) "V" blocks
    d) screws

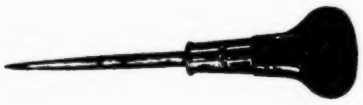
Appendix E, continued

21. A groover is used for

    a) aligning edges
    b) completing a seam
    c) making a cap strip seam
    d) cutting a channel in steel

22. This tool illustrated is used in the metal shop for

    a) punching holes in metal
    b) general purpose scribing on metal
    c) seaming sheet metal
    d) making templates

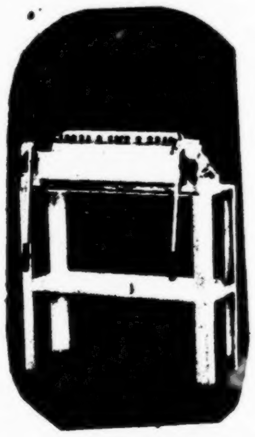


23. Metal patterns that are used repeatedly are called

    a) metal patterns
    b) templates
    c) copy plates
    d) scribe plates

24. The process of joining sheet metal parts together with liquid metal and heat is

    a) heat treating
    b) glueing
    c) soldering
    d) casting



25. This machine is used to

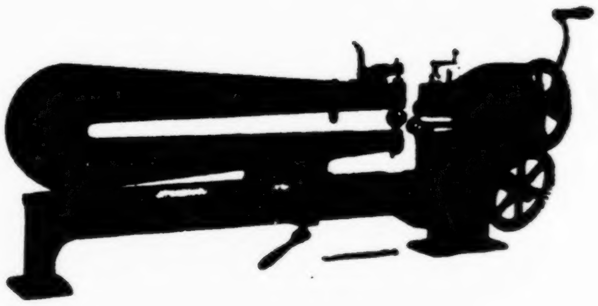
    a) bend sheet metal
    b) fold sheet metal
    c) seam sheet metal
    d) all of these

26. Which of these instruments is used to measure the thickness of sheet metal

    a) rule
    b) sheet metal gauge
    c) calipers
    d) combination square

27. One purpose of this machine is to

    a) bend metal
    b) hold metal for clamping
    c) cut sheet metal disks
    d) make double seams with sheet metal



28. Which of the following is not a holding device

  a) vises
  b) rivet set
  c) spring clamps
  d) parallel clamps

29. What does the following have in common, standing, grooved, cap strip and Pittsburg

  a) they are names of seams used to join sheet metal parts
  b) they are tools used in working sheet metal
  c) they are rollers used for shaping sheet metal parts
  d) none of these

WELDING

30. Which of the following is not a weld joint

  a) butt
  b) lap
  c) cross
  d) tee

31. When the polarity is straight

  a) the ground connection is positive and the electrode is negative
  b) the ground connection is negative and the electrode is positive
  c) the ground connection is negative and so is the electrode
  d) the ground connection and the electrode are positive

32. The letter and each number used to classify welding electrodes have a specific meaning. Which of the following is not a specific meaning

  a) electric welding
  b) welding position
  c) insulation for electrode holder
  d) tensile strength

33. When the stock being arc welded is covered with weld spatter

  a) the arc is not bright enough
  b) the electrode is held too far away from the work
  c) the amperage setting on the generator is too low
  d) the electrode is too large for the required welding

34. The shade of helmet glass commonly used in arc welding is number

  a) 3
  b) 25
  c) 10
  d) 14

35. The two gases most commonly used in flame welding are

    a) oxygen-acetylene
    b) acetylene-carbon dioxide
    c) iron oxide-oxygen
    d) hydrogen-nitrogen

36. Metals are divided into two major families

    a) hard and soft
    b) combustible and non-combustible
    c) ferrous and non-ferrous
    d) iron and steel

37. The welding arc may be started by

    a) tapping
    b) scratching
    c) a and b
    d) striking

38. Gas welding equipment may be used for

    a) cutting metals
    b) welding metals
    c) brazing metals
    d) all of these

39. To secure a weld that has proper penetration the welder must have

    a) correct electrode
    b) correct arc length
    c) correct current and travel speed
    d) all of these

40. Of the many methods of welding in use today which dominates the field

    a) gas
    b) arc and resistance
    c) a and b
    d) low carbon

41. Resistance welding is a process of

    a) fusing metals together by heat and pressure
    b) gas-shielded arc welding
    c) fusing metals together with heat obtained from the combination of gases
    d) welding with an overhead electrode made of mild steel

ASSEMBLY

42. Hand application of adhesives in assembly depends upon proper

a) bond development
b) surface preparation
c) assembly
d) all of these and more

43. The most important factor in bonding metal parts with an adhesvies is

a) reading and following manufacturer's instructions
b) applying knowledge of weight and volume for mixing adhesives
c) setting up the metal assembly
d) cleaning surfaces to be bonded

44. Which of the following has no relationship to applying adhesives

a) spatula rake
b) spray gun
c) chemical bath
d) brush

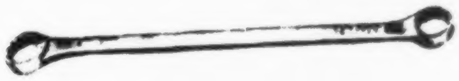
45. Match the following tools with the screws to the right

1. _____ screwdriver
46. 2. _____ allen wrench
47. 3. _____ phillips head screwdriver

a) set screw
b) phillips head screw
c) eyelet screw
d) stove bolt
e) flat, round, and oval wood screws

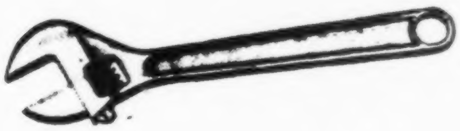
48. Which of the following wrenches cannot be used to bolt metal parts together

a)



b)

c)

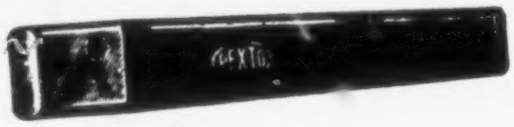


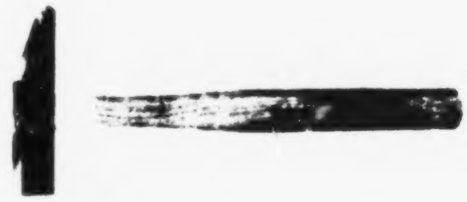
d)

Appendix E, continued

49. With which activity are the following tools associated

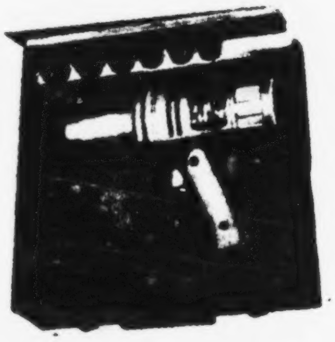
a) welding metal parts together
b) screwing metal parts together
c) riveting metal parts together
d) bolting metal parts together





50. This tool is called

a) an electric drill
b) an impact wrench
c) a soldering gun
d) a power timing wrench



51. The tool in question #50 above is used primarily in

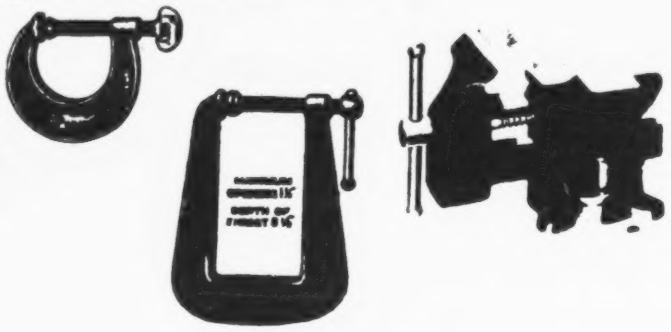
a) foundry work
b) electrical installations
c) assembly line work
d) construction work

52. The most important part of mating parts together to produce sub-assemblies is

a) aligning mated parts for assembly with an aligning punch
b) selecting parts for the sub-assembly
c) mating delicate parts with care
d) reading blueprints (exploded view drawings) to determine relationship of detail parts to be mated.

53. What would the following holding devices best be used for

a) holding parts for cutting
b) holding parts for assembly
c) holding parts for cleaning
d) all of these



GENERAL

54. The terms flat, cape, roundnose, and diamond point are names for

a) rivets
b) bolt cutters
c) cold chisels
d) metal screws

55. Files are named for their

a) shapes
b) abrasiveness
c) use
d) all of these

56. Drill sizes may be given in

a) letters
b) numbers
c) both a and b
d) none of these

57. The angle of a metal countersink may be as great as

a) 120°
b) 90°
c) 150°
d) 60°

58. Tapping in metal work means to

a) produce a threaded pipe
b) produce a threaded hole
c) pour molten metal
d) punch holes for riveting

59. In metal working the most widely used coolant is a combination of

a) water and alcohol
b) water soluble oil and water
c) machine oil and turpentine
d) alcohol and oil

60. A hollow punch is often used to punch holes in

a) heavy gauge metal
b) plastic material with metal-like qualities
c) light gauge metal
d) lead cakes for riveting

61. To thread a hole the metal worker should use a

- a) die
- b) tap
- c) screw thread
- d) pipe threader

62. For precision measurements the metal worker should use

- a) a sheet metal gauge
- b) a ruler
- c) a micrometer
- d) an adapter gauge

63. The hammer used most often by the metal worker is the

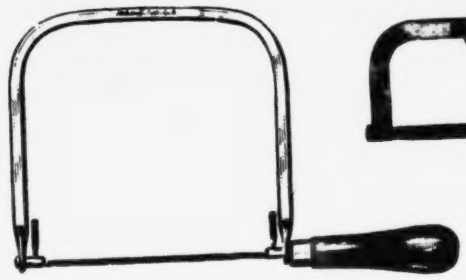
- a) paring hammer
- b) ball peen hammer
- c) claw hammer
- d) mallet

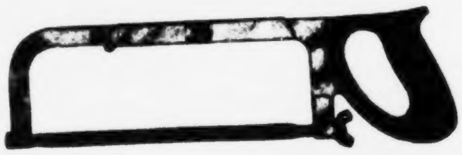
64. When a tube is flared

- a) one end is made larger
- b) one end is made smaller
- c) it is cut down the center with a flaring tool
- d) the inside is made larger

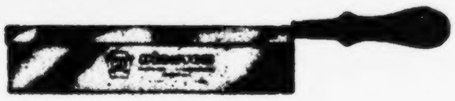
65. Which of these saws is best for cutting metal

a)





b)



c)

66. The tools most commonly used in layout are

- a) ordinary and combination squares
- b) dividers, center punch, and scratch awl
- c) micrometers and circumference rule
- d) both b and c

67. Since lines scribed on many metals are difficult to see, such surfaces are coated with

    a) a copper sulfate solution
    b) a white wash solution
    c) layout fluids
    d) a, b, or c

68. In order for the metal worker to work to dimensions it is necessary that the metal be

    a) laid out
    b) heat treated
    c) malleable
    d) measured

69. Galvanized sheet metal consists of

    a) heavy steel sheets coated with lead
    b) soft steel sheets coated with zinc
    c) iron or steel sheets coated with pure tin
    d) steel sheets coated with black iron

70. When making reference to alloys the letter "O" means

    a) work-hardened
    b) heat treated
    c) annealed
    d) kind of metal

71. Which metal has all but replaced tin plate as the primary metal in dairy equipment

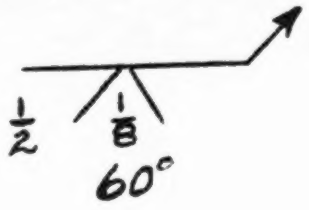
    a) aluminum
    b) dairy plate
    c) charcoal plate
    d) stainless steel

72. When metal is annealed it is

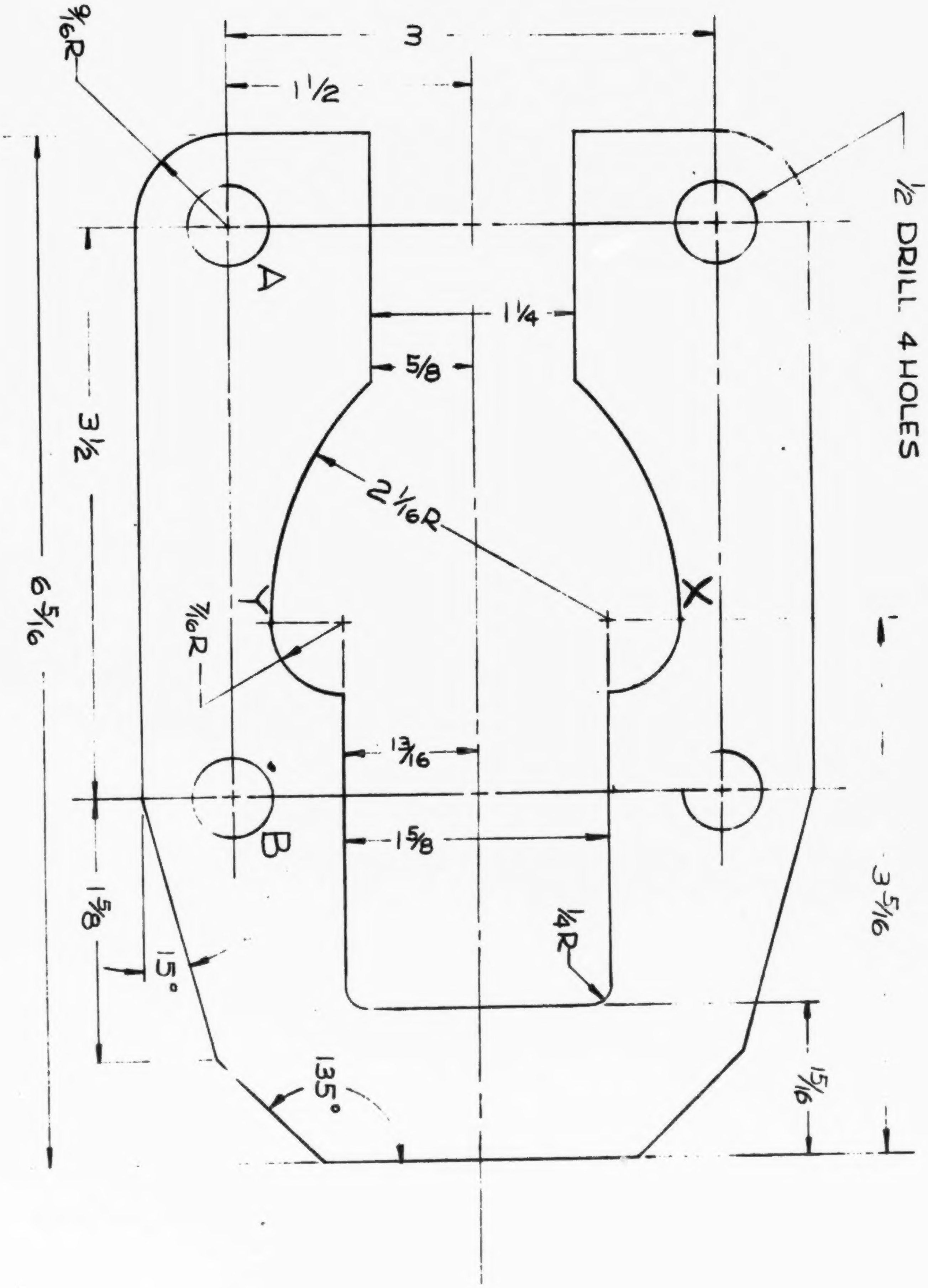
    a) hardened
    b) softened
    c) coated with another metal
    d) none of these

73. The weld symbol to the right represents which type of weld

    a) fillet
    b) groove
    c) back
    d) plug



Appendix E, continued


3
1½
9/16R
½ DRILL 4 HOLES
A
1¼
5/8
3½
2 1/16R
X
Y
7/16R
6 5/16
13/16
1 5/8
B
1 5/8
15°
¼R
3 5/16
15/16
135°

LATCH PLATE

74. A groove weld may be a

- a) square weld
- b) a "V" weld
- c) a "U" or "J" weld
- d) any of these

From the drawing of the latch plate on the preceding page, answer the following questions. NOTE all dimensions are in inches (").

75. The distance from the left edge to the center of hole "A" is

- a) 19/32
- b) 7/16
- c) 1/2
- d) 9/16

76. What is the radius of the 4 drilled holes

- a) 1/2
- b) 3/16
- c) 1/4
- d) 1

77. What is the maximum opening in the latch plate (from point X to point Y)

- a) 2-1/2
- b) 2-1/16
- c) 3
- d) 2-3/4

78. What is the smallest opening in the latch plate

- a) 2
- b) 1-1/16
- c) 1-1/4
- d) 1-3/16

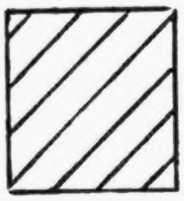
79. What is the total width of the latch plate

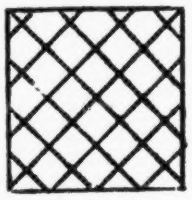
- a) 4-1/8
- b) 4-3/8
- c) 4-3/16
- d) 4

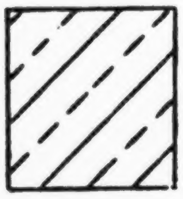
80. What is the distance between centers of holes "A" and "B"

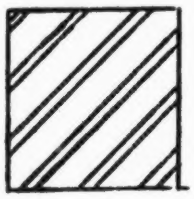
- a) 4-1/2
- b) 3-1/2
- c) 3-3/4
- d) 4-1/8

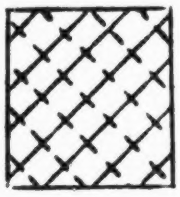
Appendix E, continued


1


2


3


4


5

81. Which of the material symbols shown above is used for steel?

a) 1
b) 2
c) 3
d) 4
e) 5

82. Which of the material symbols shown above is used for cast iron?

a) 1
b) 2
c) 3
d) 4
e) 5

83. Which of the material symbols shown above is used for aluminum?

a) 1
b) 2
c) 3
d) 4
e) 5

84. What is the name given to the drawings above?

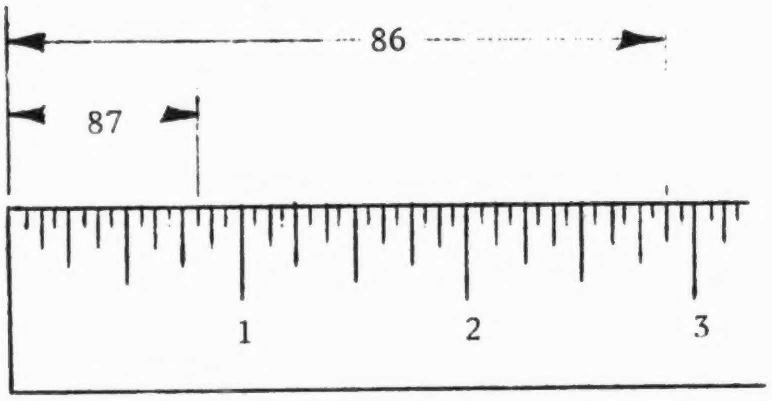
a) orthographic projection
b) sectional
c) working drawings
d) dimensioning

85. One of the most valuable skills you can acquire in metal work is

a) how to read the circumference rule
b) the formation of a positive safety attitude
c) expertness in the use of the milling machine
d) how to read the metal gage

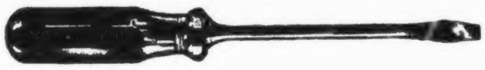
Appendix E, continued

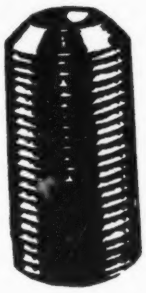
Identify the numbered lengths on the ruler illustrated below by selecting the proper length listed on the right.



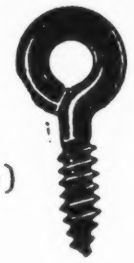
a) 3/4"
b) 1 15/16"
c) 13/16"
d) 2 5/16"
e) 2 7/8"

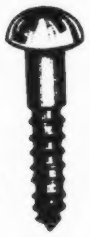
Match the tool on the left with its proper fastener on the right.

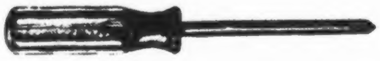
88. 

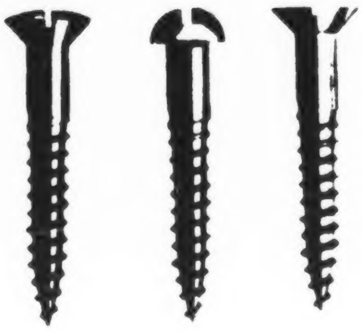
a) 

89.

b) 

c) 

90. 

d) 

ACHIEVEMENT TEST

ELECTRO-MECHANICAL INSTALLATION AND REPAIR CLUSTER

LEVEL 1

Do not open this booklet until you are told to do so. On your SEPARATE ANSWER SHEET print your name, address, and other requested information in the proper spaces then wait for further instructions.

DO NOT MAKE ANY MARKS IN THIS BOOKLET

Cluster Concept Program
Industrial Education
1967-1968

Each of the questions or incomplete statements listed below is followed by several possible answers. Choose the answer that best answers the question or completes the statement. Fill in the correct space on your separate answer sheet (A,B,C,D, OR E). Make certain the number of the question corresponds with the number you are filling in on your answer sheet. MARK ALL ANSWERS WITH A SOFT PENCIL - FILL IN THE SPACE COMPLETELY.

APPLIANCE SERVICING

1. A good conductor

   a) has a lot of planetary electrons
   b) has a lot of free electrons
   c) is always a compound
   d) will not permit electrons to flow through it easily

2. Some examples of good insulators are

   a) silver, copper, gold, and aluminum
   b) glass, mica, wood, plastic, procelain, rubber
   c) salt water, steel, tungsten
   d) none of the above

3. Electromotive force is

   a) measured in watts
   b) measured in ohms
   c) measured in amperes
   d) measured in volts

4. An ampere is

   a) the unit of potential difference
   b) one coulomb of electrons per second
   c) the unit of rate, or intensity, of current flow
   d) the unit of resistance

5. An ohm is

   a) one millionth of a megohm
   b) 1,000 milliohms
   c) the unit of resistance
   d) the unit of conductance

6. How many amperes will a **roaster** that has a resistance of 15 ohms and is connected to a 120 volt power source draw?

   a) 8
   b) 12
   c) 16
   d) 20

Appendix F, continued

7. Assuming there is no change in resistance due to heat, a device that has a resistance of 22 ohms and is rated to draw 10 amperes must be connected to a source of power rated at how many volts?

   a) 110
   b) 115
   c) 210
   d) 220

8. A device that draws 6 amps from a 120 volt source has a resistance of how many ohms?

   a) 20
   b) 30
   c) 40
   d) 50

9. A circuit that is not complete is called
   a) a short circuit
   b) an open circuit
   c) a grounded circuit
   d) a series circuit

10. If both sides of the circuit touch each other

    a) it is called a short circuit
    b) you would get a shock if you touched the device
    c) the resistance of the circuit would increase
    d) all of the above

11. If you get a shock when you touch the frame of a device, the device

    a) has a short
    b) is grounded
    c) is open
    d) will not operate

12. If one device of many in a series circuit becomes shorted

    a) none of the devices will work
    b) the shorted device is the only one that will have a voltage drop across it
    c) each of the other devices will have more current than normal
    d) each of the other devices will have more voltage drop than normal

13. A tramsformer that has a single tapped coil is called

    a) an isolation transformer
    b) an autotransformer
    c) a ballast
    d) a step-down transformer

14. A group of copper bars embedded in a laminated iron cylinder and shorted together at each end with a copper or aluminum ring is called a

    a) universal armature
    b) field winding
    c) squirrel cage rotor
    d) single phase armature

15. A tap is used for

    a) threading a bolt
    b) drilling a hole
    c) threading a hole
    d) tightening a bolt

16. The device used to turn down commutators is an

    a) arbor press
    b) bench vice
    c) pedestal grinder
    d) metal lathe

17. If you must work on any electrical equipment when moisture is present, and the equipment must remain energized, what should you do

    a) stand on a good insulator
    b) use insulated tools
    c) wear insulated gloves
    d) all of the above

18. If the points on a switch controlling a circuit become shorted

    a) nothing will work in the circuit
    b) the circuit cannot be turned off
    c) the circuit cannot be turned on
    d) the resistance of the circuit will be reduced

19. If one of the branches of a parallel circuit becomes shorted

    a) it will blow a fuse
    b) the circuit resistance will be reduced to zero
    c) the short would have to be located with a self-powered test instrument
    d) no current will flow through the good devices

20. The type of motor used in a kitchen blender is

    a) shaded-pole motor
    b) universal motor
    c) smaller motor than a mixer
    d) larger motor than a mixer

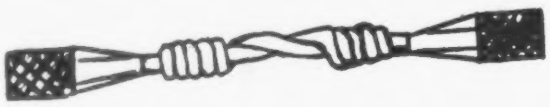
21. Electric mixers usually

    a) use the governor type of speed control
    b) have less different speeds than the blender
    c) use the tapped-field method of speed control
    d) use the adjustable brush method of speed control

22. If the motor runs jerkily in a series of spurts, the trouble may be

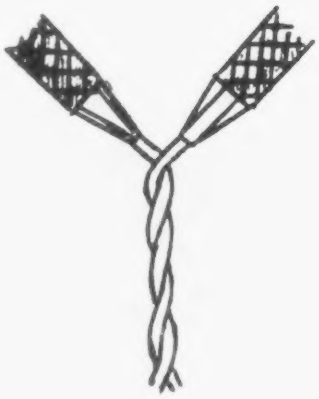
    a) shorted capacitor
    b) open speed control resistor
    c) speed control set too low
    d) points welded together

23. Idenfity the following types of splices



    a) Knotted tap splice
    b) Western Union splice
    c) Pigtail splice
    d) Tap splice

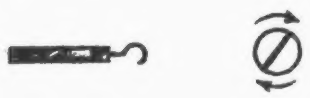
24.

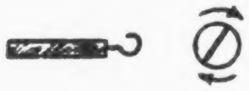


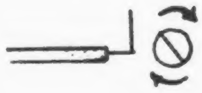
    a) Pigtail splice
    b) Tap splice
    c) Western Union splice
    d) Common Tap splice

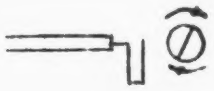
Appendix F, continued

25. Which is the correct method of connecting a wire under a terminal screw?

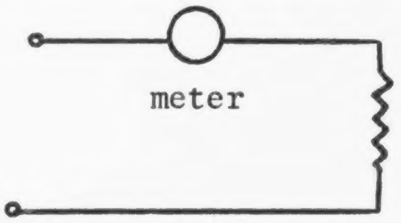

A


B


C


D

26. To measure current the meter in the diagram below is connected in



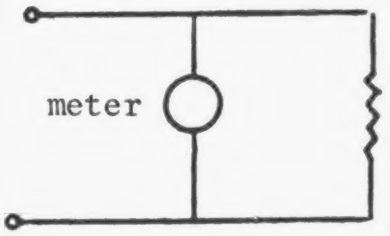
a) parallel

b) series

27. What type of meter would be used to measure current

a) ammeter
b) voltmeter
c) ohmmeter
d) watt meter

28. To measure voltage the meter in the diagram below is connected in



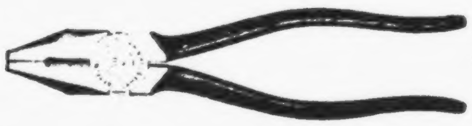
a) parallel

b) series

29. What type of meter would be used in the diagram above

a) ammeter
b) voltmeter
c) ohmmeter
d) wattmeter

30.

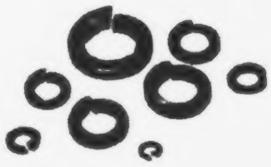


a) combination pliers
b) straight pliers
c) electricans pliers
d) diagonal cutters
e) channellock pliers

31.

a) wood screw
b) cap screw
c) machine screw
d) stove bolt
e) sheet metal screw

32.



a) grommet
b) lock washers
c) solderless connectors
d) flat washers
e) shake washer

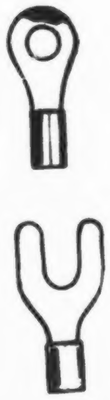
33.

a) stillson wrench
b) pipe wrench
c) torque wrench
d) adjustable wrench
e) combination wrench

34.

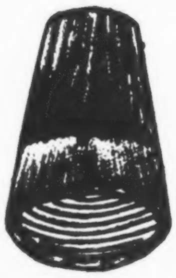
a) alligator clips
b) high voltage probe
c) continuity tester
d) battery clips
e) wire connectors

35.



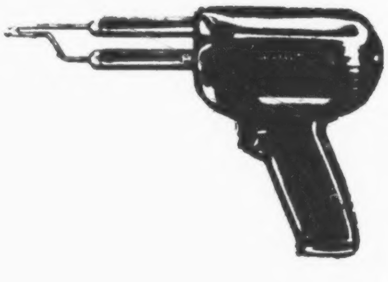
a) wire connectors
b) solderless terminals
c) battery clips
d) alligator clips
e) terminal strips

36.



a) wire nut
b) solderless terminals
c) alligator clip
d) binding post
e) test clip

37.



a) soldering gun
b) soldering iron
c) soldering copper
d) spot welder
e) welding gun

RADIO AND TELEVISION

38. A television tuner operates at frequencies

    a) the same as a superheterodine radio
    b) from 50 to 200 times higher than a broadcast radio receiver
    c) lower than a broadcast radio receiver
    d) none of the above

39. Most tuner failures are

    a) in the balum coil
    b) caused by tube failure
    c) faulty filters and traps
    d) mechanical

40. To determine if the oscillator is working

    a) check plate of oscillator with a .01 M F D capicator
    b) watch for horizontal thin lines on the raster
    c) check for a negative voltage on grid of mixer
    d) check the coupling condenser

41. To determine if the mixer is operating properly

    a) check plate voltage
    b) observe the raster for the presence of "snow"
    c) check for a lighted filament
    d) none of the above

42. A reliable method of checking the RF amplifier would be to

    a) touch or scratch the antenna terminal
    b) listen to the sound for defects
    c) check for negative voltage on test point of tuner
    d) scratch plate of oscillator

43. The key check point for the I F strip is

    a) I F filter capicator
    b) video detector load resistor
    c) 1st. I F plate voltage
    d) 2nd. or 3rd. I F plate voltage (depending on the number of I F circuits

44. The most likely suspect for a weak fly back pulse is a

    a) vertical output tube
    b) horizontal output tube
    c) AGC amplifier
    d) none of these

45. The key test point in troubleshooting the vertical oscillator is the

    a) coupling capacitator
    b) grid of the vibrator
    c) grid of the oscillator tube
    d) Sync output

46. The purpose of the AFC system is to

    a) provide smooth DC voltages to horizontal oscillator
    b) control feedback signal
    c) greater positive plate voltage
    d) maintain 15,750 cycles to grid of horizontal output

47. With the Sync separator tube removed and the sides of the picture crooked, trouble would be

    a) oscillator
    b) ABC
    c) video 1F
    d) flyback transformer

48. The function of the vertical sweep circuit is to

    a) operate the vertical hold control
    b) generate a 60 cycle signal that will produce a sawtooth current in the vertical deflection coils
    c) operate height control
    d) provide voltages for retrace blanking

49. In order for a tube to conduct

    a) control grid must be negative
    b) filament must reach a high temperature
    c) cathode must be positive
    d) the plate must be positive

50. Maximum brightness and minimum contrast will enable the serviceman to

    a) check the CRT
    b) see vertical retrace lines
    c) observe blanking
    d) observe syncpulses

51. The high voltage rectifier in black and white receiver has output of

    a) 12000 to 16000 volts
    b) 10,000 to 25,000
    c) 8,000 to 16,000
    d) 12,000 to 25,000

52. A circuit under test is found to have a voltage reading of 30 and a resistance of 120 ohms - the current should be

    a) 2.5 amps
    b) .5 amps
    c) .25 amps
    d) 1.5 amps

53. The boost voltage at the damper should be approximately

    a) 500 V +
    b) 800 V +
    c) 600 V +
    d) 700 V +

54. The bias voltage at the horizontal oscillator will be

    a) - 2 volts
    b) + 2 volts
    c) - or + 2 volts
    d) none of these

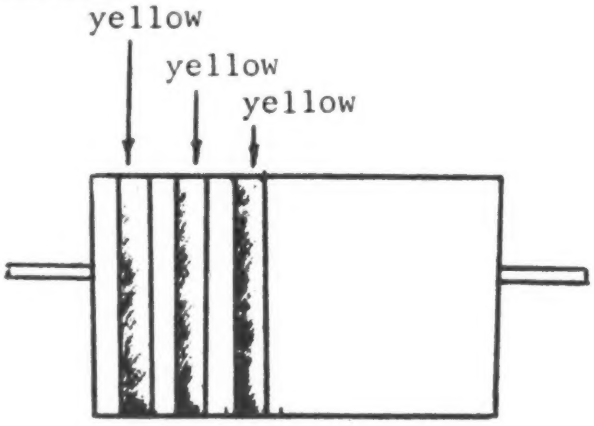
55. The bias voltage at the horizontal output will be

    a) - negative
    b) + positive
    c) may be either + or -
    d) none of the above

56. A resistor color bands of red, black, and green would have a resistance of

    a) 20 ohms
    b) 200 ohms
    c) 200,000 ohms
    d) 2 million ohms

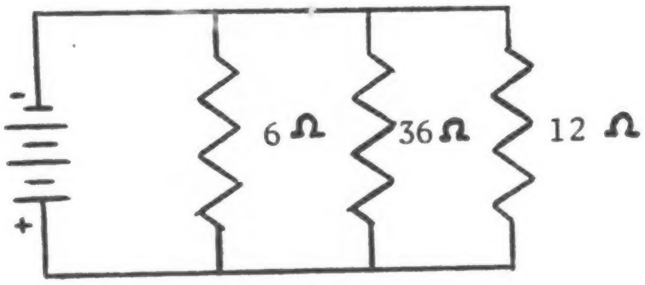
57.


yellow
yellow
yellow

The value of the resistor above is

a) 44 K ohms
b) 440 K ohms
c) 44,000 K ohms
d) K ohms

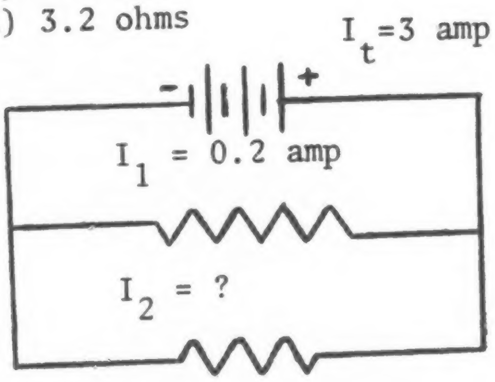
58.



The total resistance in the figure above is

a) 12 ohms
b) 6 ohms
c) 3.6 ohms
d) 3.2 ohms

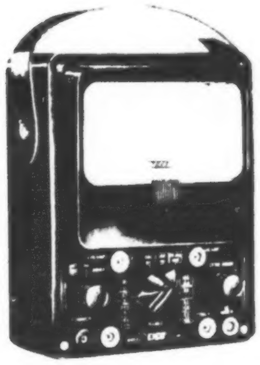
59.


I_t=3 amp
-
+
I_1 = 0.2 amp
I_2 = ?

In the figure above I_2 is equal to

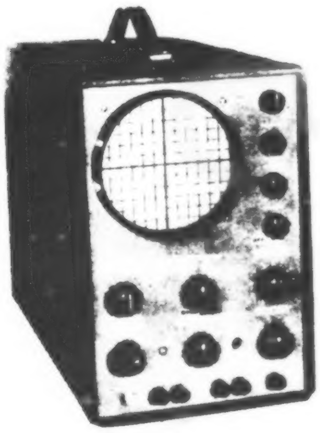
a) 2.0 amps
b) 2.4 amps
c) 2.8 amps
d) 3.0 amps

60.



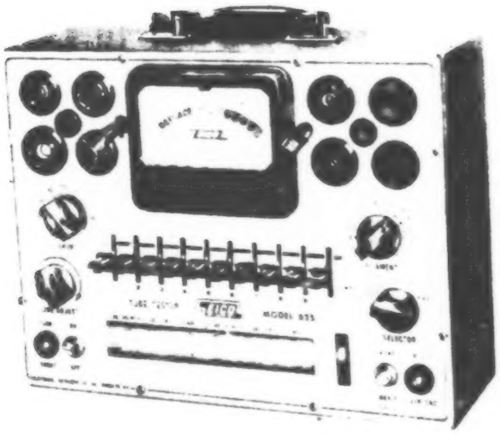
a) battery charger
b) tube tester
c) oscilloscope
d) amprobe
e) VOM

61.



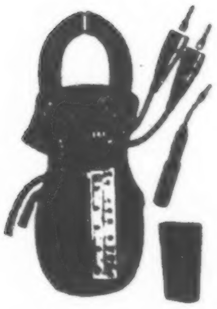
a) wheatstone bridge
b) signal generator
c) oscilloscope
d) power supply
e) multi-meter

62.



a) signal generator
b) power supply
c) oscilloscope
d) tube tester
e) amprobe

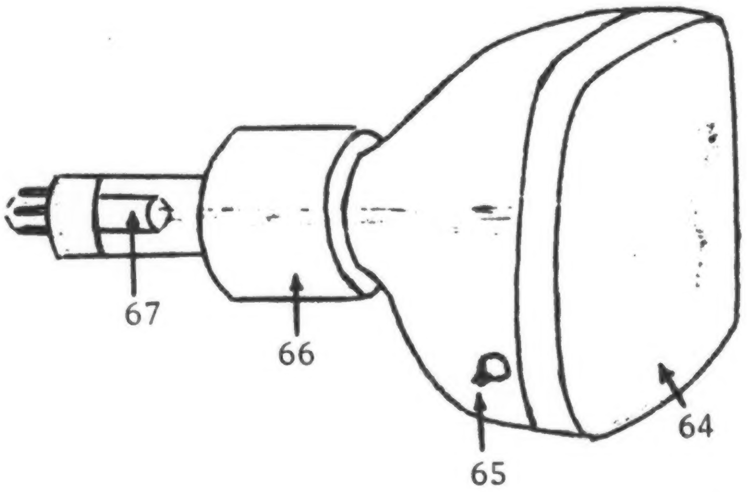
63.



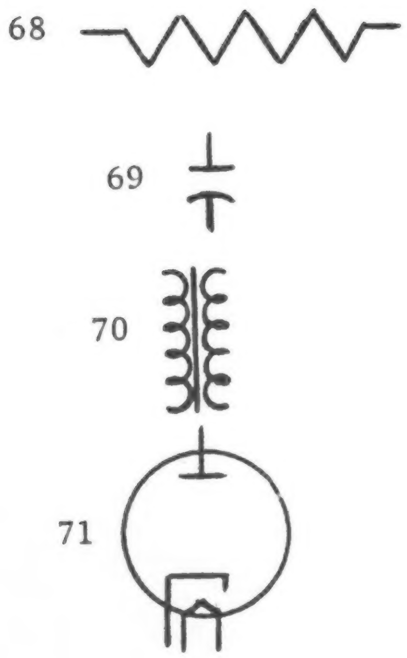
a) VOM
b) uni-probe
c) power supply
d) transitor tester
e) amprobe

Appendix F, continued

Identify the parts indicated in the picture below. Place your answer opposite the number of the part on the answer sheet.



a) CRT
b) yoke
c) electron beam
d) high voltage connection
e) raster



a) transformer
b) diode tube
c) antenna
d) capacitor
e) resistor

AIR CONDITIONING & REFRIGERATION

72. Pressure is defined as the:

    a) atmosphere
    b) weight or force per unit area
    c) volume of a gas
    d) gauge reading

73. To stop the unit from refrigerating when the desired temperature has been reached, one must provide means to:

    a) turn the thermostat warmer
    b) stop the motor
    c) defrost the cooling unit
    d) close the cabinet door.

74. The range control adjusts the:

    a) cut-out temperature
    b) cut-in temperature
    c) both cut-out and cut-in temperature
    d) differential temperature

75. Low-side floats have been discontinued on domestic refrigerators because they require

    a) too much refrigerant
    b) too much space
    c) too much space and refrigerant
    d) too much service

76. Leaks are detected in a Freon system by the use of the:

    a) soap and water test
    b) oil test
    c) ammonia swab test
    d) halide lamp test

77. The most sensitive leak detector is the

    a) halide lamp test
    b) electronic detector
    c) soap and water
    d) ammonia swab

78. The best solder for sweating copper joints is

    a) 50-50 solder
    b) resin core
    c) acid core
    d) silver solder

79. Air in the system produces a

    a) low suction pressure
    b) high suction pressure
    c) low discharge pressure
    d) high head pressure

80. Refrigerators should always be charged by adding refrigerant into the

    a) high side of the cycle
    b) low side of the cycle
    c) either side, it makes no difference
    d) compressor

81. The purpose of the condenser in the refrigeration system is to

    a) remove water
    b) maintain proper pressure
    c) prevent gas from escaping
    d) remove heat

82. Bubbles in the liquid line indicate that there is

    a) air in the system
    b) a shortage of refrigerant
    c) too much refrigerant
    d) nothing is wrong

83. Moisture in a Freon - 12 system will

    a) not harm the unit
    b) cause a refrigerant leak
    c) freeze in the refrigerant control orifice, eventually clogging it
    d) form sulphurous acid from the indoor area

84. The recommended device used to clean motor control contact points is a

    a) power grinder
    b) emery cloth
    c) oil stone
    d) fine file

85. The function of the evaporator is to

a) reject heat from the system
b) increase the density of the refrigerant
c) meter the flow of refrigerant through the system
d) absorb heat from the air or water surrounding it

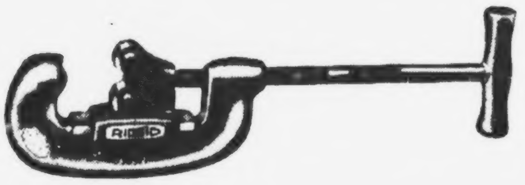
86. The hermetic compressor is normally serviced in

a) the field
b) the shop
c) by replacing it
d) with a monkey wrench and screwdriver

87. In calculating the cooling load for a residence it is necessary to determine

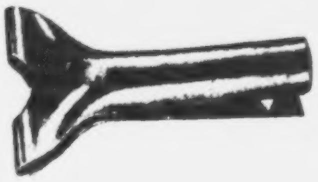
a) the heat loss in BTU
b) the heat gain in BTU
c) the size of the heating plant
d) the amount of hot water consumed per day

88.



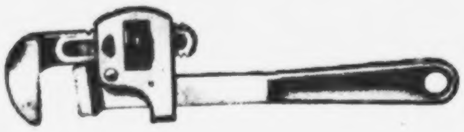
a) conduit bender
b) pipe cutter
c) fuse puller
d) wire skinner

89.



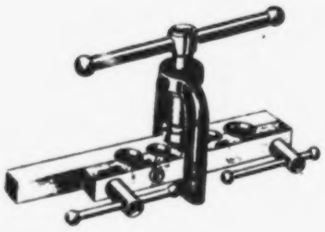
a) wire skinner
b) wire cutter
c) B-X armor cutter
d) cable ripper

90.



a) vice grips
b) box wrench
c) pipe wrench
d) adjustable wrench

91.



a) flaring tool
b) tubing bender
c) tap wrench
d) combination wrench

TYPEWRITER

92. What escapements require synchronization?

    a) 10, 12 space
    b) 12, 16 space
    c) 16, 10, 12 space
    d) 6, 8, 14, 16 space

93. The machine is in six o'clock position when:

    a) the backspace keylever is held down
    b) the fixed dog is holding escapement
    c) the loose dog is straight up and down with a tooth of escapement wheel
    d) during tabulation

94. The purpose of the Fold-A-Matic is to:

    a) feed paper into carriage
    b) control line lock
    c) disengage ribbon drive
    d) inspect and clean internal parts

95. Line lock operates during

    a) typing or tabulating into the right margin
    b) typing into left margin
    c) carriage returning into left margin
    d) backspacing into right margin

96. When the carriage is in the right margin, one of the following can be operated:

    a) space key
    b) type bar
    c) backspace key
    d) none of the above

97. The purpose of the margin release mechanism is to allow:

    a) the operator to bypass the right margin only
    b) the operator to bypass the right and left margins
    c) the operator to bypass the left margin only
    d) the operator to restore jammed type bars

98. When the space key is held down, carriage movement is prevented by:

    a) loose dog
    b) fixed dog
    c) line lock
    d) backspace pawl

99. The purpose of the ribbon drive clutch assemblies is to:

    a) release ribbon drive during tabulation
    b) release ribbon drive during use of carriage release levers
    c) allow ribbon drive clutch shaft to rotate counterclockwise only
    d) allow ribbon drive clutch shaft to rotate clockwise only

100. During tabulation the ribbon drive shaft

    a) is disengaged
    b) rotates counterclockwise
    c) rotates clockwise
    d) drives left ribbon spool

101. The ribbon will not raise when

    a) selector is in red position
    b) selector is in center position
    c) selector is in black position
    d) selector is in stencil position

102. When would both ribbon reverse plungers be down?

    a) when both ribbon spools are empty
    b) when both ribbon spools are half full
    c) when right spool is empty
    d) when left spool is empty

103. When the touch control regulator lever is down

    a) the ribbon will not raise
    b) the keyboard will be linelocked
    c) the keyboard will have the heaviest touch
    d) the keyboard will have the lightest touch

104. The tabulator blade will stop movement of the carriage when contacting:

    a) a set tabulator stop
    b) the loose dog
    c) the fixed dog
    d) the tabulator brake

105. The tabulator brake does not operate:

a) during long tabulator operations
b) during typing
c) during any tabulation operations
d) during short tabulation operations

106. Tabulator stops on elite space machines can be set:

a) at odd carriage scale positions
b) at any carriage scale position
c) at even carriage scale positions
d) with tabulator clear key

107. When the tabulator key is fully depressed

a) tabulator brake will not operate
b) carriage will not move
c) loose dog will be holding the carriage
d) ribbon will not drive

108. The ribbon drive and reverse shaft rotates

a) clockwise during carriage return
b) counterclockwise during carriage return
c) counterclockwise at all times
d) clockwise at all times

109. When the ribbon reverse toggle is locked to the front:

a) ribbon will not drive
b) left ribbon spool will wind ribbon
c) right ribbon spool will wind ribbon
d) ribbon is disengaged

110. The line lock adjusting plate prevents an occasional escapement lock up:

a) if an escapement trip occurs before contacting the right margin stop
b) when the loose dog releases the escapement wheel at left margin
c) when escapement is normal
d) in fine pitch machines, if a trip should occur when machine is line locked

111. What supplies tension to move the carriage to the left?

a) operator, during carriage return
b) main spring
c) tabulator friction brake
d) backspace pawl

APPENDIX G

(SCHOOL H)

CONSTRUCTION CLUSTER

STUDENT OCCUPATIONAL CHOICES

N = 12

OCCUPATIONS	First Choice		Second Choice		Third Choice	
	pre	post	pre	post	pre	post
CARPENTER	7*	8*	1	1	2	0
AIR CONDITIONING	0	0	1	0	0	0
ASSEMBLER	1	0	0	0	0	0
ELECTRICIAN	1	0	2	1	0	1
MASON	2	0	0	1	1	0
MACHINIST	1	2	1	0	0	1
BUSINESS MACHINE SERVICEMAN	0	1	1	1	1	0
SHEET METAL WORKER	0	0	0	0	1	1
PAINTER	1	0	4	3	2	3
PLUMBER	1	0	0	0	5	4
HOME APPLIANCE SERVICEMAN	0	0	0	1	0	0
RADIO AND TV SERVICEMAN	1	1	2	3	1	1
WELDER	0	0	1	1	1	1

*Number of students selecting each occupation on pre and post-measures.

(SCHOOL C)

CONSTRUCTION CLUSTER

STUDENT OCCUPATIONAL CHOICES

N = 11

OCCUPATIONS	First Choice		Second Choice		Third Choice	
	pre	post	pre	post	pre	post
CARPENTER	2*	4*	3	3	0	1
AIR CONDITIONING	0	0	1	0	0	1
ASSEMBLER	0	0	0	1	0	0
ELECTRICIAN	0	0	0	1	2	1
MASON	2	3	4	2	1	0
MACHINIST	1	0	0	1	1	1
BUSINESS MACHINE SERVICEMAN	1	0	0	0	0	0
SHEET METAL WORKER	1	0	0	1	0	2
PAINTER	1	0	2	0	3	1
PLUMBER	0	0	1	0	1	3
HOME APPLIANCE SERVICEMAN	0	0	0	0	2	0
WELDER	2	2	0	2	0	1

*Number of students selecting each occupation on pre and post-measures.

Appendix G, continued

(SCHOOL A)

CONSTRUCTION CLUSTER

STUDENT OCCUPATIONAL CHOICES

N = 15

OCCUPATIONS	First Choice		Second Choice		Third Choice	
	pre	post	pre	post	pre	post
CARPENTER	8*	9*	3	3	1	1
AIR CONDITIONING	0	0	0	0	0	0
ASSEMBLER	0	0	0	0	0	0
ELECTRICIAN	3	2	1	2	3	7
MASON	0	2	5	1	1	4
MACHINIST	1	1	1	2	2	0
BUSINESS MACHINE SERVICEMAN	0	0	0	0	0	0
SHEET METAL WORKER	0	0	0	0	0	1
PAINTER	0	1	0	4	3	1
PLUMBER	1	0	0	2	1	0
HOME APPLIANCE SERVICEMAN	0	0	0	0	1	1
RADIO AND TV SERVICEMAN	0	0	2	0	0	0
WELDER	1	1	4	1	2	0

*Number of students selecting each occupation on pre and post-measures.

(SCHOOL D)

CONSTRUCTION CLUSTER

STUDENT OCCUPATIONAL CHOICES

N = 9

OCCUPATIONS	First Choice		Second Choice		Third Choice	
	pre	post	pre	post	pre	post
CARPENTER	1*	0*	1	3	3	1
AIR CONDITIONING	0	0	1	1	0	1
ASSEMBLER	0	0	0	0	0	0
ELECTRICIAN	2	3	0	0	1	1
MASON	4	4	2	2	0	1
MACHINIST	0	0	1	0	0	0
BUSINESS MACHINE SERVICEMAN	0	0	0	0	0	1
SHEET METAL WORKER	0	0	0	0	0	0
PAINTER	2	3	2	1	1	2
PLUMBER	0	0	1	1	1	2
HOME APPLIANCE SERVICEMAN	0	0	0	0	1	0
RADIO AND TV SERVICEMAN	1	0	1	1	1	2
WELDER	0	0	1	0	1	2

*Number of students selecting each occupation on pre and post-measures.

Appendix G, continued

(SCHOOL J)

METAL FORMING AND FABRICATION CLUSTER

STUDENT OCCUPATIONAL CHOICES

N = 15

OCCUPATIONS	First Choice		Second Choice		Third Choice	
	pre	post	pre	post	pre	post
CARPENTER	1*	1*	1	3	2	5
AIR CONDITIONING	1	0	2	1	0	1
ASSEMBLER	0	0	0	1	3	1
ELECTRICIAN	2	1	1	2	0	0
MASON	0	0	1	0	1	2
MACHINIST	6	7	4	1	1	3
BUSINESS MACHINE SERVICEMAN	0	1	0	0	2	1
SHEET METAL WORKER	1	0	2	4	1	2
PAINTER	0	0	0	1	0	0
PLUMBER	0	0	0	0	0	0
HOME APPLIANCE SERVICEMAN	0	0	0	0	1	0
RADIO AND TV SERVICEMAN	0	1	0	2	0	0
WELDER	4	5	4	1	4	1

*Number of students selecting each occupation on pre and post-measures.

(SCHOOL F)

METAL FORMING AND FABRICATION CLUSTER

STUDENT OCCUPATIONAL CHOICES

N = 15

OCCUPATIONS	First Choice		Second Choice		Third Choice	
	pre	post	pre	post	pre	post
CARPENTER	0*	0*	0	0	0	1
AIR CONDITIONING	0	3	3	4	0	2
ASSEMBLER	0	0	2	1	1	0
ELECTRICIAN	1	1	1	3	3	1
MASON	0	0	0	0	1	0
MACHINIST	5	5	3	0	1	3
BUSINESS MACHINE SERVICEMAN	0	1	1	0	0	1
SHEET METAL WORKER	1	1	1	3	4	2
PAINTER	0	0	1	0	0	1
PLUMBER	0	0	0	0	0	0
HOME APPLIANCE SERVICEMAN	0	0	1	0	0	2
RADIO AND TV SERVICEMAN	1	0	1	0	2	3
WELDER	7	4	1	4	3	0

*Number of students selecting each occupation on pre and post-measures.

Appendix G, continued

(SCHOOL E)

METAL FORMING AND FABRICATION CLUSTER

STUDENT OCCUPATIONAL CHOICES

N = 9

OCCUPATIONS	First Choice		Second Choice		Third Choice	
	pre	post	pre	post	pre	post
CARPENTER	1*	1*	1	3	2	0
AIR CONDITIONING	0	0	0	1	1	0
ASSEMBLER	0	0	0	0	0	0
ELECTRICIAN	0	1	1	0	1	1
MASON	1	0	0	1	0	1
MACHINIST	2	1	2	1	0	3
BUSINESS MACHINE SERVICEMAN	0	1	3	0	1	0
SHEET METAL WORKER	1	0	0	0	0	0
PAINTER	1	3	0	0	2	1
PLUMBER	0	0	1	0	0	1
HOME APPLIANCE SERVICEMAN	1	0	0	1	0	0
RADIO AND TV SERVICEMAN	2	0	0	2	2	1
WELDER	0	2	1	0	0	1

*Number of students selecting each occupation on pre and post-measures

Appendix G, continued

(SCHOOL G)

ELECTRO-MECHANICAL CLUSTER

STUDENT OCCUPATIONAL CHOICES

N = 5

OCCUPATIONS	First Choice		Second Choice		Third Choice	
	pre	post	pre	post	pre	post
CARPENTER	0*	2*	1	0	0	0
AIR CONDITIONING	0	0	0	1	2	1
ASSEMBLER	0	0	0	0	0	0
ELECTRICIAN	1	2	1	0	1	0
MASON	0	0	1	2	1	0
MACHINIST	0	0	1	0	0	1
BUSINESS MACHINE SERVICEMAN	0	0	0	0	0	0
SHEET METAL WORKER	0	0	0	0	0	1
PAINTER	0	0	0	0	0	0
PLUMBER	0	0	0	0	0	1
HOME APPLIANCE SERVICEMAN	0	0	1	0	1	1
RADIO AND TV SERVICEMAN	2	1	0	2	0	0
WELDER	2	0	0	0	0	0

*Number of students selecting each occupation on pre and post-measures.

Appendix G, continued

(SCHOOL M)

ELECTRO-MECHANICAL CLUSTER

STUDENT OCCUPATIONAL CHOICES

N = 10

OCCUPATIONS	First Choice		Second Choice		Third Choice	
	pre	post	pre	post	pre	post
CARPENTER	1*	0*	1	1	0	0
AIR CONDITIONING	1	2	2	1	2	3
ASSEMBLER	0	0	0	1	0	0
ELECTRICIAN	2	3	1	1	2	1
MASON	0	0	0	0	0	0
MACHINIST	1	2	2	0	1	0
BUSINESS MACHINE SERVICEMAN	0	0	1	2	1	1
SHEET METAL WORKER	0	0	0	0	0	1
PAINTER	0	0	0	1	0	4
PLUMBER	0	0	0	0	0	0
HOME APPLIANCE SERVICEMAN	0	0	1	2	2	1
RADIO AND TV SERVICEMAN	4	3	2	1	1	1
WELDER	2	0	0	1	0	0

*Number of students selecting each occupation on pre and post-measures.

APPENDIX H

(SCHOOL A)

CONSTRUCTION CLUSTER

PREPARATIONAL MODES IDENTIFIED AS MOST IMPORTANT FOR OCCUPATIONAL ENTRY BY CLUSTER CONCEPT STUDENTS

N = 15

PREPARATIONAL MODES	STUDENT OPINION					
	First Choice		Second Choice		Third Choice	
	pre	post	pre	post	pre	post
COMPLETE HIGH SCHOOL	12*	5*	0	3	0	2
ON-THE-JOB TRAINING	1	5	6	6	3	0
JOB CORPS	0	0	0	0	0	0
NIGHT SCHOOL	1	0	0	0	1	1
ARMED FORCES	0	2	2	2	1	5
TECHNICAL INSTITUTE	1	1	1	0	2	1
EVENING WORK	0	0	2	2	5	3
APPRENTICESHIP	0	2	3	2	2	2
SUMMER SCHOOL	0	0	0	0	1	0
COMMUNITY COLLEGE	0	0	1	0	0	0
OTHERS: SPECIFY	0	0	0	0	0	0

*Number of students selecting each preparational mode on pre and post measures.

Appendix H, continued

(SCHOOL C)

CONSTRUCTION CLUSTER

PREPARATIONAL MODES IDENTIFIED AS MOST IMPORTANT FOR OCCUPATIONAL ENTRY BY CLUSTER CONCEPT STUDENTS

N = 11

PREPARATIONAL MODES	STUDENT OPINION First Choice		Second Choice		Third Choice	
	pre	post	pre	post	pre	post
COMPLETE HIGH SCHOOL	11*	7*	0	0	0	1
ON-THE-JOB TRAINING	1	1	4	3	4	1
JOB CORPS	0	0	1	0	2	2
NIGHT SCHOOL	0	0	0	1	0	0
ARMED FORCES	0	0	0	1	2	0
TECHNICAL INSTITUTE	0	0	2	1	0	0
EVENING WORK	0	0	2	0	1	1
APPRENTICESHIP	0	0	2	2	1	1
SUMMER SCHOOL	0	0	0	1	1	3
COMMUNITY COLLEGE	0	2	1	0	0	3
OTHERS: SPECIFY	0	0	0	0	0	0

*Number of students selecting each preparational mode on pre and post measures.

Appendix H, continued

(SCHOOL D)

CONSTRUCTION CLUSTER

PREPARATIONAL MODES IDENTIFIED AS MOST IMPORTANT FOR OCCUPATIONAL ENTRY BY CLUSTER CONCEPT STUDENTS

N = 9

PREPARATIONAL MODES	STUDENT OPINION					
	First Choice		Second Choice		Third Choice	
	pre	post	pre	post	pre	post
COMPLETE HIGH SCHOOL	8*	9*	0	0	0	0
ON-THE-JOB TRAINING	0	0	1	2	3	1
JOB CORPS	0	0	0	0	1	0
NIGHT SCHOOL	0	0	0	0	2	0
ARMED FORCES	1	1	1	2	0	0
TECHNICAL INSTITUTE	0	0	0	0	4	1
EVENING WORK	0	0	1	1	0	2
APPRENTICESHIP	0	0	3	3	1	3
SUMMER SCHOOL	0	0	0	0	0	0
COMMUNITY COLLEGE	0	0	4	2	0	3
OTHERS: SPECIFY	0	0	0	0	0	0

*Number of students selecting each preparational mode on pre and post measures.

Appendix H, continued

(SCHOOL H)

CONSTRUCTION CLUSTER

PREPARATIONAL MODES IDENTIFIED AS MOST IMPORTANT FOR OCCUPATIONAL ENTRY BY CLUSTER CONCEPT STUDENTS

N = 15

PREPARATIONAL MODES	STUDENT OPINION First Choice		Second Choice		Third Choice	
	pre	post	pre	post	pre	post
COMPLETE HIGH SCHOOL	7*	7*	1	0	0	1
ON-THE-JOB TRAINING	2	1	4	2	0	5
JOB CORPS	0	0	0	0	0	0
NIGHT SCHOOL	0	0	0	2	0	1
ARMED FORCES	0	0	0	0	1	0
TECHNICAL INSTITUTE	0	0	0	0	0	0
EVENING WORK	0	0	0	2	2	1
APPRENTICESHIP	0	1	1	1	5	1
SUMMER SCHOOL	0	0	0	0	0	0
COMMUNITY COLLEGE	0	1	2	1	1	0
OTHERS: SPECIFY	0	0	0	0	0	0

*Number of students selecting each preparational mode on pre and post measures.

Appendix H, continued

(SCHOOL E)

METAL FORMING AND FABRICATION CLUSTER

PREPARATIONAL MODES IDENTIFIED AS MOST IMPORTANT FOR OCCUPATIONAL ENTRY BY CLUSTER CONCEPT STUDENTS

N = 9

PREPARATIONAL MODES	STUDENT OPINION					
	First Choice		Second Choice		Third Choice	
	pre	post	pre	post	pre	post
COMPLETE HIGH SCHOOL	3*	3*	4	1	0	0
ON-THE-JOB TRAINING	2	0	1	2	1	2
JOB CORPS	0	0	0	0	0	1
NIGHT SCHOOL	0	0	1	0	0	0
ARMED FORCES	0	0	1	0	0	1
TECHNICAL INSTITUTE	1	2	1	0	1	2
EVENING WORK	0	0	1	1	0	0
APPRENTICESHIP	0	1	0	1	5	1
SUMMER SCHOOl	0	0	0	0	0	0
COMMUNITY COLLEGE	2	0	0	1	1	0
OTHERS: SPECIFY	0	0	0	0	0	0

*Number of students selecting each preparational mode on pre and post measures.

(SCHOOL F)

METAL FORMING AND FABRICATION CLUSTER

PREPARATIONAL MODES IDENTIFIED AS MOST IMPORTANT FOR OCCUPATIONAL ENTRY BY CLUSTER CONCEPT STUDENTS

N = 15

PREPARATIONAL MODES	STUDENT OPINION First Choice		Second Choice		Third Choice	
	pre	post	pre	post	pre	post
COMPLETE HIGH SCHOOL	12*	11*	0	1	1	2
ON-THE-JOB TRAINING	0	1	5	7	4	3
JOB CORPS	0	0	1	1	0	2
NIGHT SCHOOL	0	0	0	0	1	0
ARMED FORCES	0	0	2	0	0	1
TECHNICAL INSTITUTE	1	0	0	0	1	2
EVENING WORK	0	0	0	0	0	2
APPRENTICESHIP	0	2	7	5	6	2
SUMMER SCHOOL	0	0	0	0	0	0
COMMUNITY COLLEGE	0	1	1	0	1	0
OTHERS: SPECIFY	0	0	0	1	0	0

*Number of students selecting each preparational mode on pre and post measures.

(SCHOOL J)

METAL FORMING AND FABRICATION CLUSTER

PREPARATIONAL MODES IDENTIFIED AS MOST IMPORTANT FOR OCCUPATIONAL ENTRY BY CLUSTER CONCEPT STUDENTS

N = 15

PREPARATIONAL MODES	STUDENT OPINION First Choice		Second Choice		Third Choice	
	pre	post	pre	post	pre	post
COMPLETE HIGH SCHOOL	9*	8*	3	3	0	0
ON-THE-JOB TRAINING	3	2	5	4	4	4
JOB CORPS	0	0	0	0	0	0
NIGHT SCHOOL	0	0	1	1	2	3
ARMED FORCES	0	1	2	1	1	1
TECHNICAL INSTITUTE	3	3	0	2	2	1
EVENING WORK	0	0	0	0	3	1
APPRENTICESHIP	0	0	3	0	1	3
SUMMER SCHOOL	0	0	0	0	0	0
COMMUNITY COLLEGE	0	0	1	3	2	1
OTHERS: SPECIFY	0	0	0	0	0	0

*Number of students selecting each preparational mode on pre and post measures.

Appendix H, continued

(SCHOOL G)

ELECTRO-MECHANICAL CLUSTER

PREPARATIONAL MODES IDENTIFIED AS MOST IMPORTANT FOR OCCUPATIONAL ENTRY BY CLUSTER CONCEPT STUDENTS

N = 5

PREPARATIONAL MODES	STUDENT OPINION					
	First Choice		Second Choice		Third Choice	
	pre	post	pre	post	pre	post
COMPLETE HIGH SCHOOL	5*	5*	0	0	0	0
ON-THE-JOB TRAINING	0	0	2	0	0	3
JOB CORPS	0	0	0	0	0	0
NIGHT SCHOOL	0	0	0	0	0	0
ARMED FORCES	0	0	0	3	3	1
TECHNICAL INSTITUTE	0	0	0	0	1	0
EVENING WORK	0	0	1	1	0	0
APPRENTICESHIP	0	0	1	0	1	0
SUMMER SCHOOL	0	0	0	0	0	0
COMMUNITY COLLEGE	0	0	1	1	0	1
OTHERS: SPECIFY	0	0	0	0	0	0

*Number of students selecting each preparational mode on pre and post measures.

Appendix H, continued

(SCHOOL M)

ELECTRO-MECHANICAL CLUSTER

PREPARATIONAL MODES IDENTIFIED AS MOST IMPORTANT FOR OCCUPATIONAL ENTRY BY CLUSTER CONCEPT STUDENTS

N = 10

PREPARATIONAL MODES	STUDENT OPINION First Choice		Second Choice		Third Choice	
	pre	post	pre	post	pre	post
COMPLETE HIGH SCHOOL	8*	5*	0	1	0	0
ON-THE-JOB TRAINING	0	1	1	5	5	3
JOB CORPS	0	0	0	0	1	0
NIGHT SCHOOL	0	0	0	0	0	0
ARMED FORCES	0	0	4	0	1	1
TECHNICAL INSTITUTE	2	1	1	1	1	1
EVENING WORK	0	0	0	0	0	0
APPRENTICESHIP	0	1	4	2	1	1
SUMMER SCHOOL	0	0	0	0	0	0
COMMUNITY COLLEGE	0	0	0	0	1	2
OTHERS: SPECIFY	0	0	0	0	0	1

*Number of students selecting each preparational mode on pre and post measures.

APPENDIX I

SCHOOL A: CONSTRUCTION CLUSTER

N = 15

STUDENT RESPONSES TO SPECIFIED OCCUPATIONAL CHARACTERISTICS

	CHARACTERISTICS	YES		NO		NOT SURE	
		pre	post	pre	post	pre	post
1.	Jobs preferred available throughout country	16	11	0	2	1	1
2.	Resident displacement required	4	2	7	7	2	2
3.	Vertical advancement within job available	14	12	0	1	3	1
4.	Broad background is needed	10	9	3	2	3	1
5.	Occupations require growth on job	11	10	1	0	5	5
6.	Prefers present area for living	11	10	0	0	2	0
7.	Long range salary improvement available	3	2	13	11	1	2
8.	Preference of interest over money	3	2	2	11	1	2
9.	Expects tool and skill changes	11	13	1	0	3	1
10.	Needs broad training rather than for specific job	13	11	1	2	1	2
11.	Job skills are more important than human relations	8	7	3	4	4	4
12.	Status or prestige associated with job	9	5	2	0	4	10
13.	Use job as stepping stone	2	7	4	1	9	7
14.	Expects to stay on initial job	12	12	1	2	2	1
15.	There is vertical mobility within the field	7	6	1	2	7	7
16.	Specialize in one trade for success	2	5	8	3	5	7
17.	Choose job whose technology doesn't change	5	1	9	12	1	2

SCHOOL C: CONSTRUCTION CLUSTER

N = 11

STUDENT RESPONSES TO SPECIFIED OCCUPATIONAL CHARACTERISTICS

CHARACTERISTICS	YES		NO		NOT SURE	
	pre	post	pre	post	pre	post
1. Jobs preferred available throughout country	10	10	0	1	1	0
2. Resident displacement required	4	4	4	3	2	3
3. Vertical advancement within job available	9	6	0	2	2	3
4. Broad background is needed	5	5	3	3	3	3
5. Occupations require growth on job	5	7	0	1	6	3
6. Prefers present area for living	6	4	4	2	1	5
7. Long range salary improvement available	10	8	0	1	1	2
8. Preference of interest over money	1	3	7	7	3	0
9. Expects tool and skill changes	6	6	1	2	4	3
10. Needs broad training rather than for specific job	7	7	2	1	2	3
11. Job skills are more important than human relations	4	6	4	4	3	1
12. Status or prestige associated with job	7	9	2	0	2	1
13. Use job as stepping stone	7	6	0	0	4	5
14. Expects to stay on initial job	8	8	0	1	3	2
15. There is vertical mobility within the field	8	5	0	0	3	5
16. Specialize in one trade for success	4	1	3	3	3	7
17. Choose job whose technology doesn't change	4	4	3	4	4	3

SCHOOL D: CONSTRUCTION CLUSTER

N = 9

STUDENT RESPONSES TO SPECIFIED OCCUPATIONAL CHARACTERISTICS

CHARACTERISTICS	YES		NO		NOT SURE	
	pre	post	pre	post	pre	post
1. Jobs preferred available throughout country	9	8	1	1	0	1
2. Resident displacement required	1	0	5	5	3	4
3. Vertical advancement within job available	8	8	2	0	0	2
4. Broad background is needed	7	6	0	2	3	2
5. Occupations require growth on job	5	7	2	1	3	2
6. Prefers present area for living	4	1	2	4	4	5
7. Long range salary improvement available	8	10	0	0	2	0
8. Preference of interest over money	2	1	6	6	2	2
9. Expects tool and skill changes	6	5	2	1	3	4
10. Needs broad training rather than for specific job	6	7	1	2	3	1
11. Job skills are more important than human relations	7	7	1	0	1	3
12. Status or prestige associated with job	4	6	0	1	6	1
13. Use job as stepping stone	1	6	5	1	4	1
14. Expects to stay on initial job	6	7	1	1	3	1
15. There is vertical mobility within the field	5	5	1	0	2	4
16. Specialize in one trade for success	1	5	2	1	5	3
17. Choose job whose technology doesn't change	2	5	4	4	2	0

SCHOOL E: METAL FORMING AND FABRICATION CLUSTER

N = 9

STUDENT RESPONSES TO SPECIFIED OCCUPATIONAL CHARACTERISTICS

CHARACTERISTICS	YES		NO		NOT SURE	
	pre	post	pre	post	pre	post
1. Jobs preferred available throughout country	8	8	1	1	0	0
2. Resident displacement required	4	2	1	3	4	4
3. Vertical advancement within job available	6	4	1	2	2	3
4. Broad background is needed	7	6	1	1	0	2
5. Occupations require growth on job	5	6	1	1	3	2
6. Prefers present area for living	4	3	1	2	4	4
7. Long range salary improvement available	8	8	0	0	1	1
8. Preference of interest over money	1	1	8	7	0	1
9. Expects tool and skill changes	6	4	0	1	3	3
10. Needs broad training rather than for specific job	7	5	2	2	0	2
11. Job skills are more important than human relations	4	5	3	3	1	1
12. Status or prestige associated with job	4	5	0	1	5	3
13. Use job as stepping stone	3	4	4	2	2	3
14. Expects to stay on initial job	6	7	2	1	1	1
15. There is vertical mobility within the field	3	6	1	2	5	1
16. Specialize in one trade for success	3	2	4	5	2	2
17. Choose job whose technology doesn't change	1	2	7	5	1	2

Appendix I, continued

SCHOOL F: METAL FORMING AND FABRICATION CLUSTER

N = 15

STUDENT RESPONSES TO SPECIFIED OCCUPATIONAL CHARACTERISTICS

	CHARACTERISTICS	YES		NO		NOT SURE	
		pre	post	pre	post	pre	post
1.	Jobs preferred available throughout country	10	13	1	1	4	1
2.	Resident displacement required	7	3	6	7	2	5
3.	Vertical advancement within job available	15	14	0	0	0	1
4.	Broad background is needed	12	13	1	1	2	1
5.	Occupations require growth on job	8	8	1	2	6	5
6.	Prefers present area for living	4	7	5	2	6	6
7.	Long range salary improvement available	14	14	0	1	1	0
8.	Preference of interest over money	1	3	2	1	2	5
9.	Expects tool and skill changes	11	8	2	1	2	5
10.	Needs broad training rather than for specific job	13	13	1	0	1	2
11.	Job skills are more important than human relations	10	10	2	3	3	1
12.	Status or prestige associated with job	11	12	0	0	4	3
13.	Use job as stepping stone	6	9	2	4	7	2
14.	Expects to stay on initial job	6	12	3	0	6	3
15.	There is vertical mobility within the field	10	10	4	2	1	3
16.	Specialize in one trade for success	6	7	4	5	5	3
17.	Choose job whose technology doesn't change	3	0	10	8	2	7

SCHOOL G: ELECTRO-MECHANICAL CLUSTER

N = 5

STUDENT RESPONSES TO SPECIFIED OCCUPATIONAL CHARACTERISTICS

CHARACTERISTICS	YES		NO		NOT SURE	
	pre	post	pre	post	pre	post
1. Jobs preferred available throughout country	4	4	1	0	0	1
2. Resident displacement required	2	3	2	1	1	1
3. Vertical advancement within job available	2	1	3	2	0	2
4. Broad background is needed	2	3	2	0	1	2
5. Occupations require growth on job	4	2	0	2	0	0
6. Prefers present area for living	2	3	2	2	1	0
7. Long range salary improvement available	3	4	0	1	2	0
8. Preference of interest over money	1	0	4	3	0	2
9. Expects tool and skill changes	3	3	1	1	1	1
10. Needs broad training rather than for specific job	3	4	0	0	2	1
11. Job skills are more important than human relations	3	4	1	1	1	0
12. Status or prestige associated with job	2	1	2	1	1	3
13. Use job as stepping stone	3	3	1	1	1	1
14. Expects to stay on initial job	3	5	2	0	0	0
15. There is vertical mobility within the field	0	4	3	1	2	0
16. Specialize in one trade for success	0	0	0	0	0	0
17. Choose job whose technology doesn't change	4	2	1	3	0	0

SCHOOL H: CONSTRUCTION CLUSTER

N = 15

STUDENT RESPONSES TO SPECIFIED OCCUPATIONAL CHARACTERISTICS

	CHARACTERISTICS	YES		NO		NOT SURE	
		pre	post	pre	post	pre	post
1.	Jobs preferred available throughout country	11	10	0	2	0	0
2.	Resident displacement required	0	5	5	6	0	0
3.	Vertical advancement within job available	11	12	1	0	0	0
4.	Broad background is needed	12	8	0	4	0	0
5.	Occupations require growth on job	12	5	0	3	0	4
6.	Prefers present area for living	8	6	1	4	3	2
7.	Long range salary improvement available	12	11	0	0	0	1
8.	Preference of interest over money	0	2	11	8	1	2
9.	Expects tool and skill changes	11	10	0	1	1	1
10.	Needs broad training rather than for specific job	12	10	0	1	0	1
11.	Job skills are more important than human relations	11	8	0	1	1	3
12.	Status or prestige associated with job	8	9	0	0	4	3
13.	Use job as stepping stone	7	4	3	5	2	3
14.	Expects to stay on initial job	11	9	1	2	0	1
15.	There is vertical mobility within the field	10	9	1	2	1	2
16.	Specialize in one trade for success	2	6	6	3	4	2
17.	Choose job whose technology doesn't change	1	4	10	6	1	1

Appendix I, continued

SCHOOL J: METAL FORMING AND FABRICATION CLUSTER

N = 15

STUDENT RESPONSES TO SPECIFIED OCCUPATIONAL CHARACTERISTICS

CHARACTERISTICS	YES		NO		NOT SURE	
	pre	post	pre	post	pre	post
1. Jobs preferred available throughout country	14	14	1	1	0	0
2. Resident displacement required	4	4	6	6	5	5
3. Vertical advancement within job available	10	11	1	2	4	2
4. Broad background is needed	10	10	2	2	3	3
5. Occupations require growth on job	11	13	0	0	4	2
6. Prefers present area for living	11	7	2	2	2	6
7. Long range salary improvement available	13	12	1	0	1	3
8. Preference of interest over money	2	2	9	10	4	3
9. Expects tool and skill changes	10	12	2	0	3	3
10. Needs broad training rather than for specific job	11	12	2	0	2	3
11. Job skills are more important than human relations	10	10	2	2	3	3
12. Status or prestige associated with job	11	11	0	1	4	3
13. Use job as stepping stone	6	6	2	4	7	5
14. Expects to stay on initial job	14	11	0	1	1	3
15. There is vertical mobility within the field	7	9	1	0	7	6
16. Specialize in one trade for success	4	3	7	7	6	5
17. Choose job whose technology coesn't change	4	5	8	8	3	2

Appendix I, continued

SCHOOL M: ELECTRO-MECHANICAL CLUSTER

N = 10

STUDENT RESPONSES TO SPECIFIED OCCUPATIONAL CHARACTERISTICS

CHARACTERISTICS	YES		NO		NOT SURE	
	pre	post	pre	post	pre	post
1. Jobs preferred available throughout country	10	10	0	0	0	0
2. Resident displacement required	1	1	6	6	2	2
3. Vertical advancement within job available	7	8	1	2	2	0
4. Broad background is needed	7	6	3	3	0	1
5. Occupations require growth on job	8	4	1	2	1	3
6. Prefers present area for living	7	5	3	2	0	3
7. Long range salary improvement available	9	10	0	0	1	0
8. Preference of interest over money	3	3	6	5	1	1
9. Expects tool and skill changes	4	6	3	2	3	2
10. Needs broad training rather than for specific job	4	6	5	4	1	0
11. Job skills are more important than human relations	5	4	4	5	1	1
12. Status or prestige associated with job	5	8	2	1	3	1
13. Use job as stepping stone	1	4	6	4	3	2
14. Expects to stay on initial job	5	5	4	4	1	1
15. There is vertical mobility within the field	4	5	5	1	1	4
16. Specialize in one trade for success	7	5	1	2	2	3
17. Choose job whose technology doesn't change	1	1	8	8	1	1

OE 6000 (REV. 9-66)

DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
OFFICE OF EDUCATION

ERIC REPORT RESUME

(TOP)

ERIC ACCESSION NO.

CLEARINGHOUSE ACCESSION NUMBER

RESUME DATE: 08 ‾31‾ 68
P.A.
T.A.

IS DOCUMENT COPYRIGHTED? YES ☐ NO ☒
ERIC REPRODUCTION RELEASE? YES ☒ NO ☐

TITLE
The Implementation and Further Development of Experimental Cluster Concept Programs through Actual Field Testing and Evaluation at the Secondary School Level. ([redacted])

PERSONAL AUTHOR(S)
Maley, Donald and Mietus, Walter S.

INSTITUTION (SOURCE)
University of Maryland, Department of Industrial Education, College Pk. Md.
SOURCE CODE

REPORT/SERIES NO. GA VX03

OTHER SOURCE
SOURCE CODE

OTHER REPORT NO.

OTHER SOURCE
SOURCE CODE

OTHER REPORT NO.

PUB'L. DATE 08 -31 - 68
CONTRACT/GRANT NUMBER Project 7-0853; Grant No. OEG-08-000853 1865 (085)

PAGINATION, ETC.
423 pages

RETRIEVAL TERMS
Research Vocational Education
Cluster Concept Programs in Vocational Education
Effects of Vocational Education on Students
Evaluation and Implementation of Cluster Concept Programs

IDENTIFIERS
Electro-Mechanical; Construction; Metal Forming & Fabrication Clusters

ABSTRACT

The Cluster Concept Program (C.C.P.) in vocational education had its basis in three years of continuous curriculum development and research. The C.C.P. was aimed at the preparation of youth for entry level capability in a variety of related rather than a specific occupation. A rationale was developed from research findings of various disciplines. The C.C.P., a program for the eleventh and twelfth grades was designed to enhance an individual's potential employability by virtue of offering a wider range of entrance skills and articulation across several occupational areas.

The pretest/posttest type design with four control and four experimental construction cluster groups, four control and four experimental metal fabrication cluster groups, and three control and experimental electro-mechanical cluster groups, was used to obtain an estimate of the effectiveness of the programs.

Newly developed achievement tests, rating scales, inventories, check lists, and standardized tests were used to obtain an estimate of changes in selected cognitive, affective and psychomotor behaviors. Varying degrees of attaining the objectives of the first year of the C.C.P. were observed. Significant gains in cognitive abilities of eight experimental groups with only modest gains in two groups were observed. Increased flexibility of occupational preferences and broadened interests were found. Each field operation was evaluated in terms of tasks performed by the teacher and the student, administrative support, equipment, physical facilities, and community acceptance. This research made it evident that the C.C.P. has the potential of becoming a vigorous, alternate form of vocational education.